

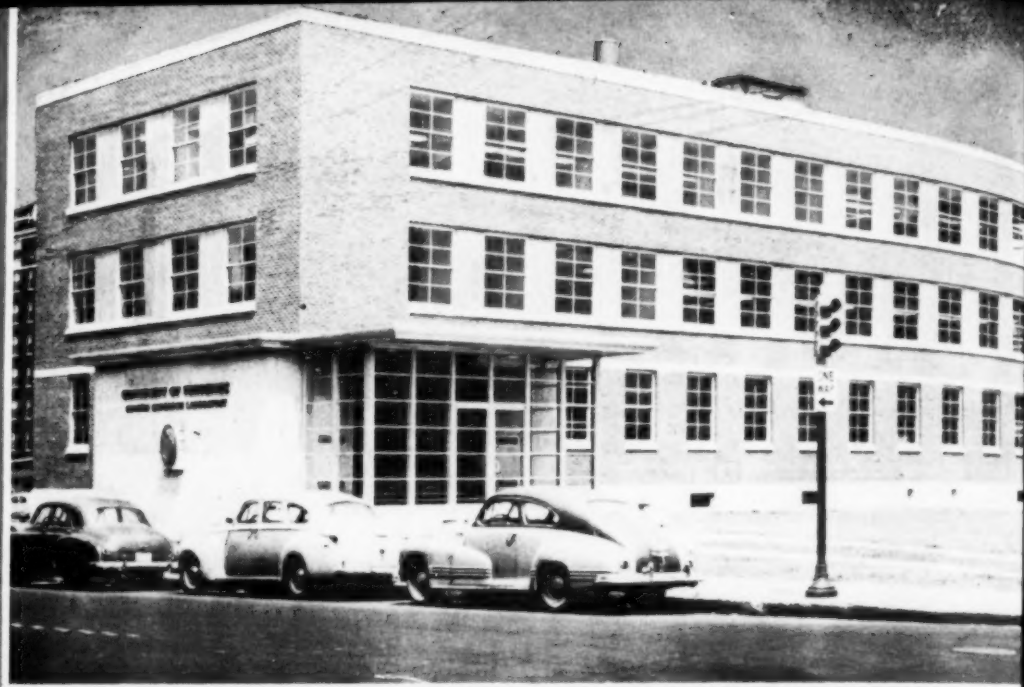
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PUBLIC HEALTH REPORTS

In this issue



FEDERAL SECURITY AGENCY • Public Health Service



Cancer Research Laboratory

University of Tennessee

A Public Health Service construction grant of \$491,584, recommended by the National Advisory Cancer Council, enabled the University of Tennessee to build this cancer research laboratory at the medical school in Memphis. It opened in 1951.

Among current investigations is one concerned with the cytological test as a case-finding technique in cervical cancer (center picture). This work is an undertaking of the Public Health Service cancer investigation unit at the University of Tennessee.

Another phase of the laboratory's work provides for training of medical students in the early diagnosis and treatment of cancer (lower picture). The program—aided by National Cancer Institute training grants—is set up so that the medical school can include the cancer problem in lectures and demonstrations.



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Published since 1878

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Prevalence of Arthritis and Rheumatism in the United States

By THEODORE D. WOOLSEY, B.A.

The importance of arthritis and rheumatism as common chronic diseases and as leading causes of suffering and disability scarcely needs to be demonstrated to anyone working in the field of public health or medicine. Numerous morbidity surveys have confirmed the significance of these diseases, and any general practitioner whose practice is not wholly confined to young people could doubtless substantiate it from his own experience.

Nevertheless, quantitative information in some detail is needed by public health organizations, rehabilitation agencies, and pharmaceutical firms for the planning of programs for the control of this group of diseases, for studying their epidemiology, and for many other purposes. Such information should include, as a minimum, data on the prevalence of the diseases to show the population groups most affected, the amount and severity of the disability caused, and the psychological and economic effect of the disability on the afflicted person and his or her family.

In 1951 the most recent statistics available on the prevalence of arthritis and rheumatism in the United States were 15 years old. From the results of the National Health Survey of 1935-36 (1) it had been estimated that there were at that time approximately 6,850,000 persons of all ages in the country with "rheumatism," including under that title all muscular rheuma-

tism, lumbago, arthritis, gout, "neuritis," and "neuralgia" (2). From the 5-year general morbidity survey in the Eastern Health District of Baltimore, 1938-42, more detailed statistics were compiled on the frequency and severity of disabling attacks and the degree of association of the prevalence of rheumatism and arthritis with various social and economic factors in an urban community. (See references 3, 4, 5, and papers referred to therein.)

New Data Collected

At the present time, with new possibilities opening up for treatment of the rheumatoid diseases, public health forces are mobilizing for concerted efforts to control these diseases and to alleviate their consequences. Hence, it is particularly important to collect up-to-date statistical information to serve the needs of research and control agencies.

Therefore, in September 1951 the Division of Public Health Methods undertook to obtain new estimates of the number of recognized cases of chronic arthritis and muscular rheumatism in the United States. An additional objective was to determine the proportion of these cases that had been seen by a doctor and the proportion that had entailed some reduction or change in the amount or type of work that the afflicted person could perform.

The data that were collected are limited in scope, but they are also broad in applicability because of the representativeness of the population upon which they were based. The procedure employed was to add six brief questions

Mr. Woolsey is a biostatistician in the Division of Public Health Methods, Public Health Service.

to the interview that is the basis of one of the regular monthly canvasses conducted by the Census Bureau's Current Population Survey. This survey is conducted in a very carefully designed sample of the population of the country. The sample is of the type known as a "probability" sample, which means that for estimates made from the sample it is possible to state the limits of error due to sampling. The interviewers of the Bureau of the Census periodically visit about 25,000 households scattered in 68 sample areas in 42 States and the District of Columbia. They obtain from some responsible person in the household information on employment, unemployment, and other economic and social characteristics of household members. The surveys usually cover only the population 14 years of age and over.

From this sample, estimates are made for the civilian population of the country as a whole, exclusive of the inmates of resident institutions such as homes for the aged, mental hospitals, and penal institutions. In September 1951 this population numbered approximately 109,000,000 persons 14 years of age and over.

The experience of the Public Health Service in household morbidity surveys indicates that the respondent for the family can give the interviewer reasonably reliable information on any specific diagnosis stated by a doctor. In the particular case of the rheumatism group of diseases, however, the average respondent probably does not distinguish clearly between the various diagnoses within the group. Consequently, this survey attempted to make only a rough division of the group into two classes—arthritis and rheumatism.

Design of the Interview

The interview questions on arthritis and rheumatism were worded as follows:

1. "This month we are making a study to find out how many people have arthritis or rheumatism or other ailments of that type, such as gout or lumbago. First of all, I'd like to check the persons in the household who have any trouble of that sort."

(All persons 14 years of age and over who were reported to have any form of arthritis or

to have fibrositis, gout, lumbago, myositis, or any form of rheumatism, *except* rheumatic fever or rheumatic heart disease, were identified. All succeeding questions dealt with the persons thus identified.)

2. "Has . . . ever been treated by a doctor for this condition, or talked to a doctor about it?"

3. If YES in 2: "Has a doctor ever told . . . what his (or her) condition is called?"

4. If YES in 3: "What did he say it was?" (The reply was coded by the interviewer as "A," if the response indicated any form of arthritis; as "R," if the response indicated fibrositis, gout, lumbago, myositis, or any form of rheumatism *except* rheumatic fever or rheumatic heart disease; as "OT" if any other disease was mentioned, such as "neuritis.")

5. "Has . . . had to cut down on or change his (or her) work or other usual activities in any way on account of this trouble?"

(When a YES answer was given the interviewer recorded the type of change that was made. Some changes that were mentioned were later edited to NO, because they seemed to represent adjustments that were only temporary or were optional on the part of the afflicted person. An example of the latter: "I never lift heavy weights whenever I can help it.")

6. "Has . . . had any definite signs of this ailment within the past month?"

From the answers to these questions by the respondents for the households in the sample, estimates were made of the number of persons in the civilian noninstitutional population of the United States, 14 years of age and over, who would have been reported to have arthritis or rheumatism, to have seen a doctor for the condition, and so forth, if every household in the United States had been visited. A few of the major results of the survey are shown in the tables and graphs that follow. A more detailed account of the survey findings will appear in a later report.

Since the estimates are based on a sample, they are, of course, subject to sampling error; where the frequencies in the tables are small this error may be relatively large. Hence, the smaller frequencies in the tables and the percentages where the base is likely to be small (in particular, percentages based upon the non-

white population) should be used with some caution. In the description of the survey results that follows it may be assumed that comparisons cited are statistically significant—unlikely to be attributable solely to random sampling fluctuations—unless otherwise noted. As in any survey, there are also errors due to biases in response. However, the careful training given to Census interviewers for the Current Population Survey, their experience with many different kinds of questions, and the preliminary testing of all questions used in this survey give a basis for confidence that such errors are not large.

Estimated Cases

The persons reported by the family respondent as having arthritis or rheumatism may be classed as "presumptive" cases. These totaled an estimated 10,104,000 persons aged 14 years and over in the United States (table 1). A comparison of this figure with the corresponding estimate from the National Health Survey of 1935-36 is, unfortunately, unreliable as an indication of trend. The questions asked and the manner of conducting the two surveys differed. Furthermore, the earlier survey covered a population that was almost entirely urban.

In answer to the question about what the doctor had called the condition, the respondent sometimes mentioned a diagnosis which was not considered to be a form of arthritis or rheumatism in this survey. This happened in 484,000 (4.8 percent) of the presumptive cases. Such cases might easily be counterbalanced by definite cases of arthritis or rheumatism that the family failed to report because they were not recognized as cases for one reason or another. A more important reason for including these cases in the tables is that the total of all cases reported by the families (presumptive cases) is the figure that is most nearly comparable with that obtained from other family studies. Another 3,206,000 cases (31.7 percent) must be considered to be in the doubtful class either because the person had not seen a doctor at all (2,540,000 cases) or because the family did not know what the doctor's diagnosis was (666,000 cases). There were, however, an estimated 6,414,000 cases (63.5 percent) which had been seen by a doctor and identified by him as arthritis, rheumatism, gout, lumbago, myositis, or fibrositis. These may be described as "diagnosed" cases, although in some instances it is likely that the statement made by the doctor represented only a preliminary opinion. In about 70 percent of the 6,414,000 cases the respondent's de-

Table 1. Estimated¹ number and percentage of cases of arthritis and rheumatism in the civilian noninstitutional population of the United States, 14 years of age and over, by sex, medical attendance, and reported diagnosis, September 1951

Medical attendance and reported diagnosis	Number (in thousands)			Percent of all cases			Percent of population		
	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females
All cases reported by families.....	10, 104	3, 914	6, 190	100. 0	100. 0	100. 0	9. 3	7. 6	10. 8
Cases seen by a doctor.....	7, 564	2, 784	4, 780	74. 9	71. 1	77. 2	6. 9	5. 4	8. 4
Doctor called it:									
Arthritis ²	4, 670	1, 560	3, 110	46. 2	39. 9	50. 2	4. 3	3. 0	5. 4
"Rheumatism" ²	1, 744	792	952	17. 3	20. 2	15. 4	1. 6	1. 5	1. 7
Other ²	484	144	340	4. 8	3. 7	5. 5	. 4	. 3	. 6
Unknown to family.....	666	288	378	6. 6	7. 4	6. 1	. 6	. 6	. 7
Cases not seen by a doctor.....	2, 540	1, 130	1, 410	25. 1	28. 9	22. 8	2. 3	2. 2	2. 5

¹ Estimates are derived from a sample survey and are therefore subject to sampling variability, which may be relatively large where the quantities shown are small.

² Arthritis includes any diagnosis reported by the family containing the word "arthritis"; "rheumatism" includes the terms: rheumatism, gout, lumbago, myositis, and fibrositis; "other" includes all other terms and diagnoses and, hence, consists of terms and diagnoses not classified as arthritis or rheumatism in this survey. This last category is included in the tables because the total of all cases reported by the families is the figure that is more nearly comparable with that obtained in other family studies.

scription of the doctor's diagnosis contained the word "arthritis." In the remainder it was simply "rheumatism" or one of the other terms that were included under that heading in this survey.

It should be emphasized that the estimate of 6,414,000 so-called "diagnosed" cases of rheumatism and arthritis among persons 14 years of age and over was obtained from information supplied by lay respondents, reporting what they believed the doctor had said. A sample of the population carefully screened for these diseases and subjected to all the procedures necessary for a firm diagnosis might give a substantially different figure. However, a screening and diagnostic study of that type would of necessity be smaller and less broadly based. It is only by linking such surveys as the one described here with more intensive studies of smaller groups that we shall be able to estimate the number of persons in the country with unquestioned cases of rheumatoid or degenerative arthritis or other forms of rheumatism. The survey of September 1951 will therefore be useful as a means of calibration, provided the identical questions used in the national survey are also incorporated in the smaller surveys to provide the link.

More Women Afflicted

Table 1 also shows the percentage distribution of the cases in these various categories for males and females separately and the percentage of the civilian noninstitutional population 14 years of age and over falling into each class, that is, the prevalence rate per 100 population. The prevalence of presumptive cases is 9.3 percent; of all cases seen by a doctor, 6.9 percent; and of diagnosed cases of rheumatism and arthritis, 5.9 percent. The prevalence among females is considerably higher than among males. There seems to be a consistency in this sex difference in all the prevalence rates in the table. It is worthy of note, however, that while the percentage prevalence for females exceeds that for males by approximately 80 percent for the diagnosed cases identified as "arthritis," the sex difference for cases identified as "rheumatism" is not statistically significant.

Figure 1 illustrates not only the contrast

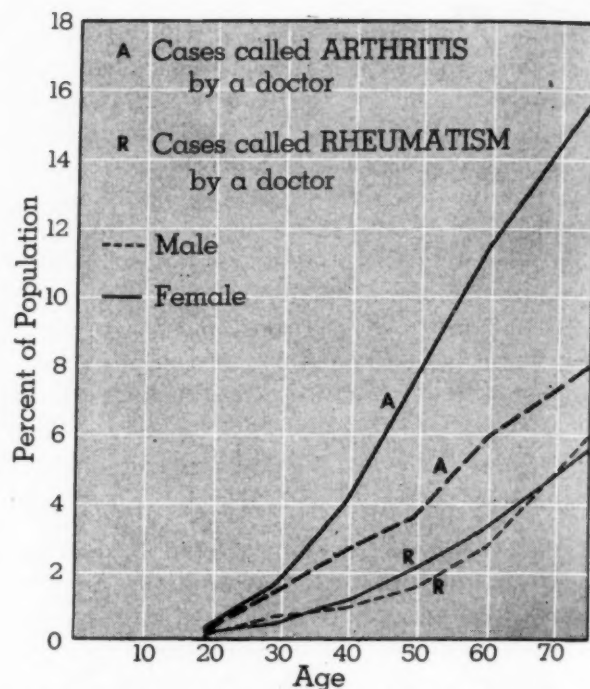


Figure 1. Prevalence of "diagnosed" arthritis and rheumatism by sex and age in the civilian noninstitutional population of the United States, September 1951.

between the sexes in the prevalence of diagnosed arthritis but also the sharp increase with age in the prevalence of both arthritis and rheumatism.

By no means all persons reported as cases by the families in the survey were sufficiently disabled to cause any material reduction or change in work or other usual activities. The kinds of changes or adjustments that were considered of sufficient importance to be counted included: giving up gainful work or housework entirely; changing to a lighter or more suitable type of work, such as a type that did not require use of the fingers; giving up all heavier parts of the work or of household chores; changing to part-time or occasional work; moving to a warmer climate; changing the conditions of work, for example, from night to day shift; giving up athletics entirely (for a young person). Among those who had seen a doctor, 31 percent had made some such change in the amount or type of work or other usual activities (table 2). The corresponding figure for those who had not seen a doctor was 13 percent. Thirty-four percent of the diagnosed cases identified as arthritis and 29 percent of those identified as rheumatism

Table 2. Estimated¹ number and percentage of cases of arthritis and rheumatism in the civilian noninstitutional population of the United States, 14 years of age and over, by residence, race, medical attendance, and reported diagnosis, September 1951

Medical attendance and reported diagnosis	Total	Urban	Rural nonfarm	Rural farm	White	Non-white
Number of cases (in thousands)						
All cases reported by families	10, 104	5, 546	2, 408	2, 150	9, 092	1, 012
Cases seen by a doctor	7, 564	4, 200	1, 874	1, 490	6, 902	662
Doctor called it:						
Arthritis ²	4, 670	2, 682	1, 206	782	4, 344	326
"Rheumatism" ²	1, 744	810	464	470	1, 526	218
Other and unknown ²	1, 150	708	204	238	1, 032	118
Cases not seen by a doctor	2, 540	1, 346	534	660	2, 190	350
Percent of all cases						
All cases reported by families	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0
Cases seen by a doctor	74. 9	75. 7	77. 8	69. 3	75. 9	65. 4
Doctor called it:						
Arthritis ²	46. 2	48. 4	50. 1	36. 4	47. 8	32. 2
"Rheumatism" ²	17. 3	14. 6	19. 3	21. 9	16. 8	21. 5
Other and unknown ²	11. 4	12. 8	8. 5	11. 1	11. 4	11. 7
Cases not seen by a doctor	25. 1	24. 3	22. 2	30. 7	24. 1	34. 6
Percent of population						
All cases reported by families	9. 3	8. 0	10. 1	13. 6	9. 2	9. 9
Cases seen by a doctor	6. 9	6. 0	7. 9	9. 5	7. 0	6. 5
Doctor called it:						
Arthritis ²	4. 3	3. 9	5. 1	5. 0	4. 4	3. 2
"Rheumatism" ²	1. 6	1. 2	2. 0	3. 0	1. 5	2. 1
Other and unknown ²	1. 1	1. 0	. 9	1. 5	1. 0	1. 2
Cases not seen by a doctor	2. 3	1. 9	2. 2	4. 2	2. 2	3. 4
Percent of cases for which a change in amount or type of work or other usual activities was reported						
All cases reported by families	26. 2	24. 9	25. 4	30. 7	25. 6	32. 0
Cases seen by a doctor	30. 8	29. 3	29. 3	37. 0	30. 1	38. 1
Doctor called it:						
Arthritis ²	33. 6	33. 2	32. 2	37. 1	33. 0	41. 7
"Rheumatism" ²	29. 4	26. 4	24. 6	39. 1	27. 7	41. 3
Other and unknown ²	21. 9	17. 8	23. 5	32. 8	21. 9	22. 0
Cases not seen by a doctor	12. 6	11. 1	11. 6	16. 4	11. 3	20. 6

^{1, 2} See footnotes, table 1.

reported a change in the amount or type of work.

The percentage of the population in each age group with diagnosed cases of arthritis or

rheumatism is shown in figure 2. The upper line shows all such cases, while the lower line is for those diagnosed cases in which the person had made a change in the amount or type of

his, or her, work. An indication of the magnitude of the economic aspects of this public health problem may be seen in this graph. From 1.5 to 5 percent of the population in the upper working ages (45 to 65) have had to give up entirely, cut down on, or make some other significant change in their work or other usual activities because of ailments described to the families by the attending physicians as some form of arthritis or rheumatism. If all presumptive cases were included, the figure would, of course, be higher.

Higher Prevalence Rates in Rural Areas

Although only a few of the survey results bearing upon the distribution of these diseases in the population can be shown here, certain variables that appear to be particularly important have been included in tables 2 and 3. A review of some of the points of interest in these tables brings out the following relationships:

1. The proportion of all presumptive cases that had been seen by a doctor was significantly lower in the rural farm population than in

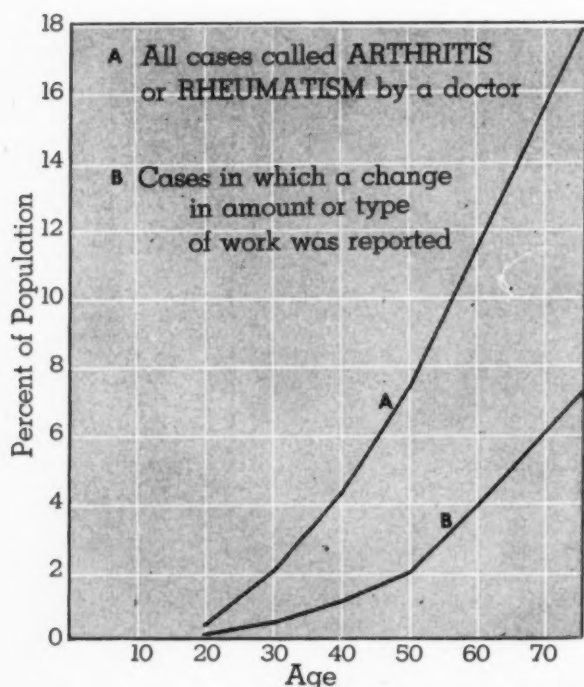


Figure 2. Prevalence of "diagnosed" arthritis and rheumatism in the civilian noninstitutional population of the United States, September 1951. (All cases, and cases in which a change in amount or type of work was reported.)

either the urban or rural nonfarm groups. In the two latter population groups the proportion is about the same (table 2).

2. The proportion of cases seen by a doctor was lower for the nonwhite population than for the white (table 2).

3. The prevalence of diagnosed cases of arthritis is higher in the population living in rural areas than it is in the cities. The same holds true for cases identified as rheumatism. The difference between rural nonfarm and rural farm populations in the prevalence of diagnosed cases of rheumatism and arthritis combined is not great enough to exclude the possibility that it is a result of random sampling variation. However, the evidence on occupational differences supports the hypothesis that rheumatism and arthritis of all forms combined are more prevalent in the population of farm areas. Since these differences in the urban and rural prevalence of diagnosed cases are partly a function of the differing proportions of cases seen by a doctor, it is also worth noting that the prevalence of all presumptive cases is also highest in the rural farm group and lowest in the urban (table 2).

4. The prevalence of presumptive cases in the nonwhite population is not significantly higher than the prevalence in the white population (table 2).

5. The proportion of presumptive cases for which a change in the amount or type of work or other usual activities was reported was higher among rural farm families than among urban or among rural nonfarm families. Furthermore, the proportion of cases associated with a change of this sort was higher in the nonwhite population than in the white population (table 2).

6. Age-adjusted prevalence rates, that is, rates that have been adjusted to make allowances for differences in the age distribution of the population being compared (table 3), show that the percentage of persons engaged in farming reported as having rheumatism or arthritis was higher than that among employed persons in general. On the other hand, "professional, technical, and kindred workers" and "clerical and kindred workers" tended to have a lower prevalence when compared with all employed persons of their own sex. These

Table 3. Estimated ¹ number and percentage of employed civilians reported by the family to have arthritis or rheumatism, by sex and occupation, September 1951

Occupation	Males			Females		
	Number (in thou- sands)	Percent of em- ployed population		Number (in thou- sands)	Percent of em- ployed population	
		Crude	Ad- justed ²		Crude	Ad- justed ²
All occupations.....	2,824	6.6	6.3	1,298	6.8	7.7
Professional, technical, and kindred workers.....	116	3.8	3.6	92	4.6	5.0
Farmers and farm managers.....	625	16.6	11.5	24	(³)	(³)
Managers, officials, proprietors, except farm.....	309	5.9	4.7	102	9.2	7.6
Clerical and kindred workers.....	130	4.8	5.2	185	3.6	5.7
Sales workers.....	100	4.3	4.5	92	6.2	7.0
Craftsmen, foremen, and kindred workers.....	546	6.6	6.1	12	(³)	(³)
Operatives and kindred workers.....	484	5.4	6.1	235	6.6	7.4
Private household workers.....	2	(³)	(³)	181	10.6	9.5
Service workers, except private household.....	187	7.2	5.8	159	7.6	7.6
Farm laborers and foremen.....	106	5.5	8.0	206	13.1	15.1
Laborers, except farm and mine.....	219	5.8	6.3	10	(³)	(³)

¹ See footnote 1, table 1.

² Age-adjusted by the "indirect method" to the total employed population of both sexes.

³ Percentages not computed because of small frequencies.

figures suggest hypotheses that should be tested in more intensive studies; without information on such factors as income, education, and diet, it is impossible to say whether the differences are due to occupation per se. The statistics suggest, however, that outdoor occupation may be a factor in determining the prevalence of arthritis and rheumatism.

7. In every occupational group in which both men and women are represented in substantial numbers, the age-adjusted prevalence rate for females is higher than that for males. Though not all of the differences are statistically significant, the pattern is consistent. Thus, the sex differences commented upon earlier cannot be entirely accounted for by the dissimilarity in the usual activities of men and women in general (table 3). Small differences between the rates for various occupations shown in this table, however, should be interpreted with caution because the sampling error is relatively large in some groups.

Summary

Some findings from the September 1951 survey of arthritis and rheumatism are presented. From the survey data it has been estimated that

there are approximately 10,104,000 persons 14 years of age and over in the United States who believe that they have arthritis or rheumatism. About 75 percent of these persons have seen a doctor about their condition. An estimated total of 6,414,000 have been told by a doctor that their condition was arthritis, "rheumatism," gout, lumbago, myositis, or fibrositis. About 5 percent of the 10 million persons who believe that they have one of these diseases apparently do not, if they reported correctly what the doctor told them; and others must also be considered doubtful cases for one reason or another. However, about one-fourth of the 10 million cases had made some significant change in the amount or type of work they performed or in their other usual activities. Sex, race, age, urban or rural residence, and occupation are examined as factors affecting the prevalence of the diseases.

REFERENCES

- (1) Perrott, George St.J., Tibbitts, Clark, and Britten, Rollo H.: The national health survey. Scope and method of the nation-wide canvass of sickness in relation to its social and economic setting. Pub. Health Rep. 54: 1663-1687 (1939). Reprint No. 2098.

- (2) U. S. Public Health Service: National health survey, 1935-1936. Preliminary Reports, Sickness and Medical Care Series, Bulletin No. 6: The magnitude of the chronic disease problem in the United States. 1938.
- (3) Collins, Selwyn D., Phillips, F. Ruth, and Oliver, Dorothy S.: Disabling illness from specific causes among males and females of various ages. Sample of white families canvassed at monthly intervals in the Eastern Health District of Baltimore, 1938-43. Pub. Health Rep. 66: 1649-1671 (1951). Reprint No. 3130.
- (4) Collins, Selwyn D., Phillips, F. Ruth, and Oliver, Dorothy S.: Age incidence of specific causes of illness found in monthly canvasses of families. Sample of the Eastern Health District of Baltimore, 1938-43. Pub. Health Rep. 66: 1227-1245 (1951). Reprint No. 3114.
- (5) Collins, Selwyn D., Phillips, F. Ruth, and Oliver, Dorothy S.: Specific causes of illness found in monthly canvasses of families. Sample of the Eastern Health District of Baltimore, 1938-43. Pub. Health Rep. 65: 1235-1264 (1950). Reprint No. 3046.

Dr. Otis L. Anderson New Chief of Bureau of State Services



The appointment of Assistant Surgeon General Otis L. Anderson as chief of the Bureau of State Services of the Public Health Service was announced by Surgeon General Leonard A. Scheele May 3, 1952. Formerly associate chief of the Bureau of Medical Services, Dr. Anderson succeeds Dr. Joseph W. Mountin, who died April 26.

Dr. Anderson entered the Commissioned Corps of the Public Health Service in 1930, after interning at the Public Health Service hospital in Baltimore, Md.

After serving on the staffs of Public Health Service hospitals in Boston, Ellis Island, and Norfolk, he was assigned in 1936 to the Virginia State Department of Health to direct its venereal disease control program. In 1940, he was named Public Health Service venereal disease control consultant to health departments and industries in Michigan, Minnesota, Wisconsin, Iowa, Illinois, Indiana, and Ohio, and in 1941 he undertook the direction of the industrial phase of the national venereal disease control program.

Dr. Anderson was appointed assistant chief of the Division of Venereal Disease in 1942. He was assigned in 1944 to New Orleans to direct the Public Health Service programs in Louisiana, Florida, Alabama, Mississippi, South Carolina, Georgia, and Tennessee. Later in 1944, he returned to Washington to administer the 23 Public Health Service hospitals. He was appointed associate chief of the Bureau of Medical Services in 1949. Dr. Anderson is a fellow of the American Medical Association and of the American College of Physicians, a diplomate of the American Board of Preventive Medicine and Public Health. He is a member of the American Public Health Association, the American Hospital Association, and the Association of Military Surgeons.

Birth Registration Completeness

United States, 1950

By SAM SHAPIRO, B.S., and JOSEPH SCHACHTER, B.B.A.

Preliminary results of a recently completed nation-wide test of birth registration indicate that birth records are now filed by attendants and hospitals for about 98 percent of the babies being born. This represents an important advance since 1940 when only 92.5 percent of the births were registered. Progress made during this period has virtually eliminated underregistration as a practical problem in more than half the country and has sharply reduced the problem in nearly all other areas.

The registration completeness test was conducted in connection with the 1950 Decennial Census of Population and Housing through the cooperative efforts of the Population and Housing Division of the Bureau of the Census, the National Office of Vital Statistics of the Public Health Service, and the State, Territorial, and independent city registration offices. From the standpoint of birth registration, the primary purpose of the test was to obtain current measures of registration completeness for States and local areas on a comparable basis. The chief interest of the Bureau of the Census in the project has been to determine variations in infant enumeration completeness by social and economic groups and to find out reasons for failure to enumerate infants.

Mr. Shapiro is chief of the natality analysis branch of the National Office of Vital Statistics and directed the 1950 test of birth registration completeness. Mr. Schachter is a statistician in the branch and had immediate supervision over many phases of the test.

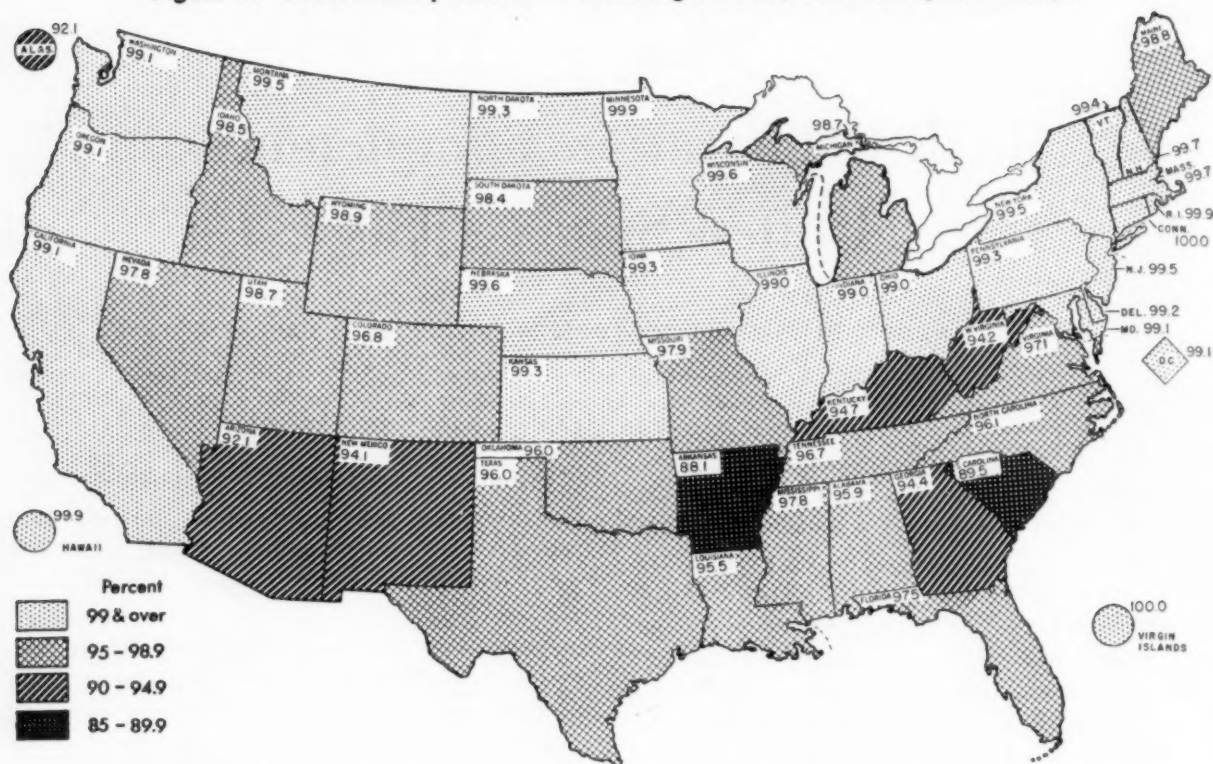
Background

In the past 30 to 40 years, the birth registration system has become one of our indispensable public institutions. A birth record is now of great importance to most people. It is called on frequently to prove age, birthplace, and parentage for such purposes as entering school, obtaining employment limited to citizens, and qualifying for pensions or social security benefits.

The value of the birth record to the individual is paralleled by its importance as a source of data for health workers. The record is used in many communities for reaching families needing public health nursing services or education in the care of the infant. Statistics derived from the record have been an essential and effective tool for planning and evaluating programs for the reduction of infant and maternal mortality. In fact, the recognized need for these statistics stimulated the organization of the birth registration system in the United States. Today, the allocation of resources to deal with aspects of infant mortality such as prematurity (immaturity) is greatly dependent upon information gathered from the birth record.

The use of birth statistics extends far beyond the health field. Available data play a part in the baby food manufacturer's plan for marketing his product, in the city or county school commission's estimate of future needs for classrooms, and in the housing expert's recommendation for new construction required to meet the trend in family size. In addition, these statistics are used extensively to study and in-

Figure 1. Percent completeness of birth registration, 1950 test (preliminary).



interpret population changes for long-range social and economic planning.

To a great extent, the capacity of the registration system for meeting these diverse demands is measured by the completeness with which births are registered. This has been recognized for many years. The history of the formative years of the national birth registration area, 1915 through 1933, is replete with instances of major efforts by health, welfare, and civic groups to insure the registration of all births (1). Despite the striking success of these campaigns, the broad range of cultural and ethnic groups within the population and the remoteness of many parts of the country from urban centers prolonged the period during which underregistration was a serious problem.

This was illustrated by the results of the first nation-wide test of birth registration completeness in the United States conducted in conjunction with the 1940 Decennial Census of Population and Housing. In 14 States only 80.0 to 89.9 percent of the births were registered and 2 States had even lower percentages (2). The results also demonstrated that registration was

especially poor among groups most likely to require public health services that depend on the birth record for case finding. Fully a fifth of the babies born to mothers with little or no education were not registered, and a seventh of the births to farm residents were missed.

Further examination of the 1940 data showed that while the registration problem centered among attendants taking care of home deliveries, registration of hospital births also lagged in some places. These findings, together with figures for local areas, formed the basis for State campaigns directed toward attendants and local registrars to improve registration. However, before all of the necessary actions could be taken, State and local vital statistics offices were overwhelmed by the war demands made upon them for copies of birth certificates. In addition, requirements of the armed forces and war-connected industries rapidly depleted their staffs.

The same factors that diverted efforts from organized promotional activities to improve registration also resulted in making millions of young adults more conscious of the importance of the birth record. Never before was

such a high premium placed on having a birth certificate. Citizenship had to be established to qualify for jobs in defense industry; applications for food ration books for new-born children frequently had to be accompanied by birth records, and birth certificates of dependent children often had to be submitted by servicemen in applying for family allowances. Moreover, hospital facilities for obstetrical care increased, and each year the proportion of births being delivered at home diminished.

After World War II, State offices of vital statistics once more turned their attention to specific measures for curtailing underregistration. While it was generally believed that the net effect of wartime conditions had been to improve the situation, an objective measure of the extent to which underregistration remained a problem was needed to direct these activities. The 1950 test of registration completeness was designed with this in mind.

With the completion of the test, the situation in counties and cities has become clarified. The results are helping registrars localize areas requiring attention, determine the reasons for

the remaining underregistration, and take remedial measures. For areas where registration incompleteness is still significant, the test also provides factors for correcting statistics derived from birth records.

Registration in 1950

The 1950 birth registration test indicated that 97.8 percent of the infants born in the early part of that year had birth certificates on file in vital statistics offices. In 23 States and the District of Columbia, birth registration completeness was over 99 percent and in only 7 States was it lower than 95 percent (fig. 1 and table 1).

Seven out of eight infants included in the test were born in hospitals, and all but a few of the hospital births were registered. For births delivered at home, however, registration was not nearly as complete. Nationally, only 88 percent of these births were registered, and in some States the proportion was considerably lower. Because of the consistent pattern of higher registration of hospital births throughout the

Table 1. Percent registration completeness of hospital births and births at home for each State, Territory, and possession, 1940 and 1950

[Figures for area in which birth occurred. Data for 1950, preliminary; for 1940, final]

Area	Total			Births in hospitals			Births not in hospitals		
	1950	1940	Percent change ¹	1950	1940	Percent change ¹	1950	1940	Percent change ¹
Continental United States.....	97.8	92.5	5.7	99.4	98.5	0.9	88.1	86.1	2.3
New England.....	99.7	98.6	1.1	99.8	99.5	.3	92.8	95.7	-3.0
Maine.....	98.8	96.1	2.8	99.5	98.7	.8	91.7	94.2	-2.7
New Hampshire.....	99.7	98.7	1.0	99.8	99.4	.4	96.9	96.3	.6
Vermont.....	99.4	97.3	2.2	99.8	96.8	3.1	95.5	97.7	-2.3
Massachusetts.....	99.7	98.9	.8	99.9	99.6	.3	91.4	95.5	-4.3
Rhode Island.....	99.9	98.8	1.1	99.9	99.7	.2	95.1	96.2	-1.1
Connecticut.....	100.0	99.4	.6	100.0	99.7	.3	100.0	97.1	3.0
Middle Atlantic.....	99.4	98.0	1.4	99.7	99.2	.5	93.8	94.5	-.7
New York.....	99.5	98.7	.8	99.7	99.4	.3	90.0	94.5	-4.8
New Jersey.....	99.5	99.0	.5	99.7	99.6	.1	93.8	96.1	-2.4
Pennsylvania.....	99.3	97.0	2.4	99.6	98.9	.7	95.3	94.3	1.1
East North Central.....	99.0	96.6	2.5	99.5	98.7	.8	89.3	93.6	-4.6
Ohio.....	99.0	95.2	4.0	99.6	98.4	1.2	88.2	90.9	-3.0
Indiana.....	99.0	96.5	2.6	99.3	97.9	1.4	94.5	95.4	-1.0
Illinois.....	99.0	96.9	2.2	99.6	99.0	.6	88.2	92.3	-4.4
Michigan.....	98.7	97.8	.9	99.2	98.8	.4	85.1	96.1	-11.4
Wisconsin.....	99.6	96.9	2.8	99.7	98.9	.8	93.7	94.4	-.7

Table 1 continued on p. 516.

Table 1. Percent registration completeness of hospital births and births at home for each State, Territory, and possession, 1940 and 1950—Continued

[Figures for area in which birth occurred. Data for 1950, preliminary; for 1940, final]

Area	Total			Births in hospitals			Births not in hospitals		
	1950	1940	Percent change ¹	1950	1940	Percent change ¹	1950	1940	Percent change ¹
West North Central.....	99.0	94.9	4.3	99.7	98.2	1.5	90.4	91.1	-0.8
Minnesota.....	99.9	99.3	.6	100.0	99.9	.1	95.4	98.2	-2.9
Iowa.....	99.3	94.6	5.0	99.5	97.6	1.9	93.4	91.0	2.6
Missouri.....	97.9	90.2	8.5	99.3	96.8	2.6	90.3	85.1	6.1
North Dakota.....	99.3	94.7	4.9	100.0	98.9	1.1	89.4	88.7	.8
South Dakota.....	98.4	95.4	3.1	99.5	97.9	1.6	79.1	92.8	-14.8
Nebraska.....	99.6	96.9	2.8	99.9	98.2	1.7	91.3	95.8	-4.7
Kansas.....	99.3	95.5	4.0	99.9	98.0	1.9	87.8	93.1	-5.7
South Atlantic.....	95.6	86.8	10.1	98.7	96.7	2.1	88.4	82.4	7.3
Delaware.....	99.2	97.4	1.8	99.9	99.6	.3	93.2	93.4	-.2
Maryland.....	99.1	97.1	2.1	99.7	99.1	.6	94.4	94.2	.2
District of Columbia.....	99.1	97.9	1.2	99.4	99.0	.4	79.8	88.6	-9.9
Virginia.....	97.1	91.9	5.7	99.5	98.7	.8	91.5	89.1	2.7
West Virginia.....	94.2	86.5	8.9	98.5	95.7	2.9	87.6	84.7	3.4
North Carolina.....	96.1	86.1	11.6	98.4	96.1	2.4	91.2	83.0	9.9
South Carolina.....	89.5	77.6	15.3	96.8	92.9	4.2	81.6	74.4	9.7
Georgia.....	94.4	81.3	16.1	98.1	96.3	1.9	87.2	76.2	14.4
Florida.....	97.5	89.9	8.5	99.2	92.5	7.2	91.8	87.4	5.0
East South Central.....	96.2	85.9	12.0	99.3	98.2	1.1	91.7	83.0	10.5
Kentucky.....	94.7	89.2	6.2	98.5	97.7	.8	88.4	87.6	.9
Tennessee.....	96.7	80.4	20.3	99.5	97.8	1.7	89.5	74.2	20.6
Alabama.....	95.9	85.0	12.8	99.6	98.6	1.0	91.0	81.9	11.1
Mississippi.....	97.8	89.8	8.9	99.6	99.3	.3	96.4	88.2	9.3
West South Central.....	94.8	84.5	12.2	98.7	96.4	2.4	82.1	78.5	4.6
Arkansas.....	88.1	75.9	16.1	97.2	95.0	2.3	75.0	72.9	2.9
Louisiana.....	95.5	86.1	10.9	98.4	97.3	1.1	84.1	79.4	5.9
Oklahoma.....	96.0	84.8	13.2	99.1	95.8	3.4	81.1	79.6	1.9
Texas.....	96.0	86.5	11.0	98.9	96.3	2.7	85.2	80.3	6.1
Mountain.....	96.6	91.5	5.6	98.9	97.9	1.0	74.5	83.2	-10.5
Montana.....	99.5	97.6	1.9	99.8	98.8	1.0	89.1	93.4	-4.6
Idaho.....	98.5	95.0	3.7	99.1	97.5	1.6	79.6	91.4	-12.9
Wyoming.....	98.9	95.6	3.5	99.4	98.8	.6	86.8	88.3	-1.7
Colorado.....	96.8	89.8	7.8	99.0	98.0	1.0	70.6	79.6	-11.3
New Mexico.....	94.1	86.4	8.9	97.6	93.8	4.1	85.1	83.5	1.9
Arizona.....	92.1	84.4	9.1	98.5	97.7	.8	53.3	68.3	-22.0
Utah.....	98.7	96.6	2.2	99.4	98.6	.8	73.4	93.0	-21.1
Nevada.....	97.8	96.2	1.7	97.9	98.2	-.3	(³)	90.2	(⁴)
Pacific.....	99.1	97.8	1.3	99.5	99.1	.4	78.0	91.4	-14.7
Washington.....	99.1	97.8	1.3	99.5	98.9	.6	70.1	91.1	-23.1
Oregon.....	99.1	97.1	2.1	99.3	98.7	.6	84.7	90.9	-6.8
California.....	99.1	98.0	1.1	99.5	99.2	.3	78.5	91.6	-14.3
Territories and possessions:									
Alaska.....	92.1	(⁵)	(⁵)	98.3	(⁵)	(⁵)	76.6	(⁵)	(⁵)
Hawaii.....	99.9	97.7	2.3	99.9	(⁵)	(⁵)	98.0	(⁵)	(⁵)
Puerto Rico.....	(⁶)	80.5	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)
Virgin Islands.....	100.0	96.4	3.7	100.0	(⁵)	(⁵)	100.0	(⁵)	(⁵)

¹ All percentage changes are relative changes from the 1940 measures of registration completeness. Decreases are indicated by minus sign (-). ² Based on 25 to 99 records. Sizable variations in percentages based on these frequencies may arise from random factors. ³ Not computed. Number of test records less than 25. Percentages based on so few records subject to considerable error. ⁴ Not applicable. ⁵ Not available. ⁶ Registration test in process.

NOTE. 1950 percentages show results of registration completeness test covering January-March 1950 live births; 1940 percentages, results of similar test covering live births in December 1939 and January-March 1940.

country, the extent to which mothers used hospital facilities played an important part in determining a State's total registration completeness. Figure 2 shows that the proportion of births occurring in hospitals varied considerably from region to region and was lowest in the southern geographic divisions.

About two-fifths of the births occurring at home were attended by midwives, relatives, or neighbors. These attendants registered 85 percent of the births they delivered as against 91 percent for physicians attending home deliveries (tables 2 and 3). Nonphysicians (predominantly midwives) were used far more often in the South Atlantic, South Central, and Mountain States than in other parts of the country. In a number of States these attendants took care of more births at home than did physicians, and in some areas they had a better record of registration.

By comparison, in the 24 States of the New England, Middle Atlantic, North Central, and Pacific areas, fewer than 5 births in every 1,000 were delivered by nonphysicians, with about two-fifths of them unregistered. The large underregistration in this group is explained in part by the fact that the attendant was often a neighbor or relative with little or no knowledge of the responsibility for filing a birth certificate.

Of the white births in the test, 98.5 percent were registered as against 93.4 percent of the nonwhite. A closer examination of the situation indicates that there was no difference between the two race groups in registration completeness of births "at home" and only a slight difference with respect to the "in hospital" births. However, when hospital and nonhospital births are combined, registration is found to be more complete in the white group than in the nonwhite because of the more frequent occurrence of white births in hospitals.

More than nine-tenths of the nonwhites were Negro, the remainder being about evenly divided into "Indian" and "other." The last group consists mainly of births to parents of Chinese or Japanese extraction. Of the nonwhite groups, the Indian had the poorest record of registration completeness (85 percent). Nonphysicians attended over one-fifth of the Indian births and filed certificates for less than half (44 percent) of the infants they delivered. In

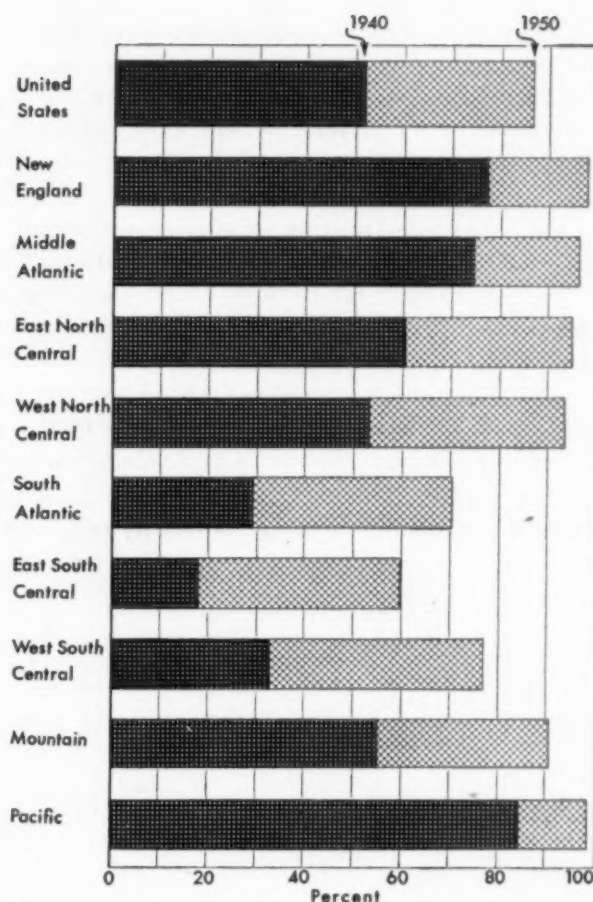


Figure 2. Proportion of births occurring in hospitals for each geographic division, 1940 and 1950.

the "other" category, registration completeness was over the 97-percent mark. Most of these births occurred in areas where extensive use is made of hospital facilities for maternity care.

National Changes Since 1940

A comparison of results from the 1940 and 1950 registration tests shows that substantial gains were made during the intervening years. For the United States as a whole, the relative improvement was 5.7 percent—registration completeness rising from 92.5 percent in 1940 to 97.8 percent in 1950 (table 1).

About four-fifths of the increase is explained by the trend toward use of hospital facilities for obstetrical care (3). In 1940, about half of the confinements were in hospitals; by 1950 this proportion had increased to seven-eighths of the total (fig. 2). If the continuing efforts of State and local registrars to obtain complete

registration among hospitals and among home attendants had succeeded only in maintaining the 1940 levels in each group, registration completeness for the country would have risen to 96.8 percent because of the change in the proportion of hospital births.

The remaining portion of the improvement was due to moderate increases in registration of both "in hospital" and "at home" births. During the period of the 1940 test, birth registration completeness of hospital births was already high—98.5 percent (4). Hence, although States with near perfect registration of such births retained their high standards and other States

were able to approach close to the 100 percent mark, the total improvement was necessarily modest.

With respect to deliveries at home, registration completeness in 1940 was only 86 percent, but here, too, the increase was small—2 percent. To some extent, this limited improvement is explained by the change in composition of attendants delivering babies in the home. Doctors, whose registration practices are generally better than those of the nonphysician group, took care of about three-fifths of the home deliveries in 1950 as against four-fifths in 1940.

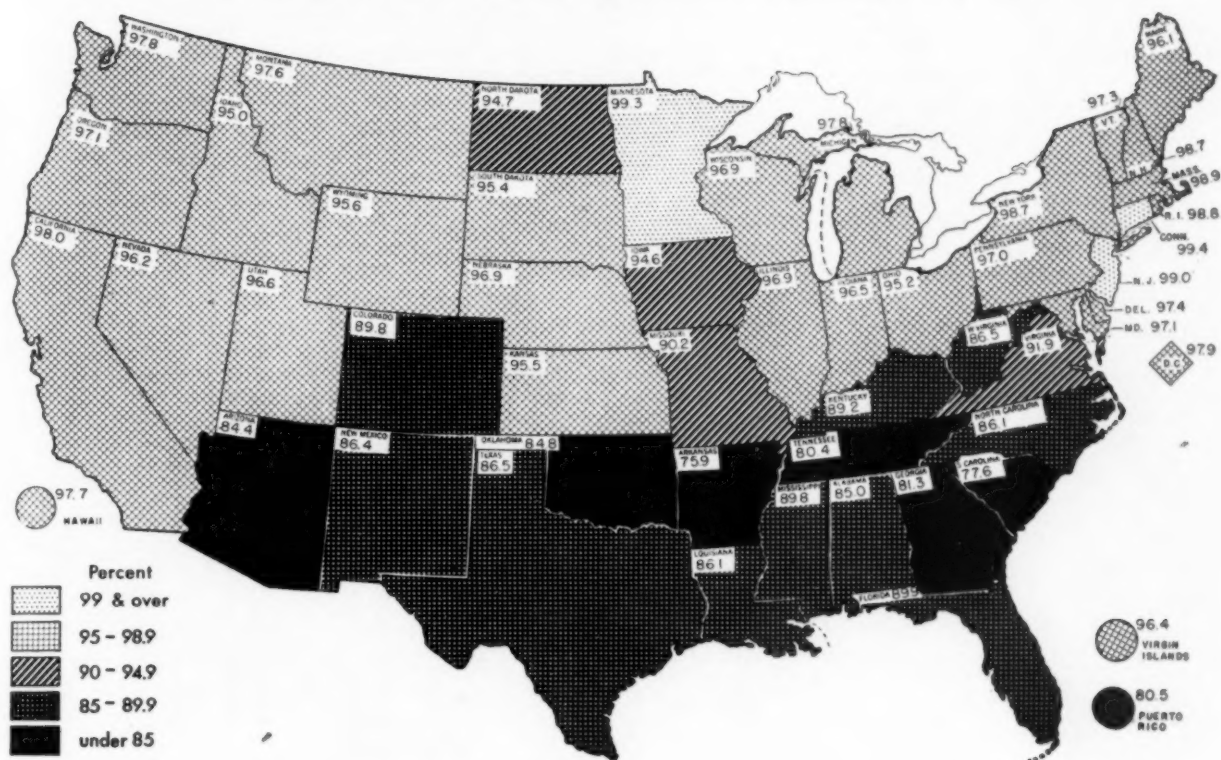
Table 2. Registration completeness by race and person in attendance at birth for each geographic division, 1950

[Figures for area in which birth occurred. Data preliminary, based on births in January–March 1950]

Area and race	Total		Physician in hospital		Physician not in hospital		Midwife, other, and not specified	
	Total infant cards	Percent matched	Total infant cards	Percent matched	Total infant cards	Percent matched	Total infant cards	Percent matched
Continental United States.....	780, 343	97. 8	674, 221	99. 4	61, 859	90. 6	44, 263	84. 5
White.....	674, 793	98. 5	618, 329	99. 5	44, 981	91. 7	11, 483	73. 9
Nonwhite.....	105, 550	93. 4	55, 892	98. 1	16, 878	87. 7	32, 780	88. 3
Negro.....	98, 154	93. 6	50, 005	98. 2	16, 303	87. 6	31, 846	89. 4
Indian.....	3, 872	85. 0	2, 715	96. 6	339	90. 9	818	44. 4
Other races.....	3, 524	97. 4	3, 172	99. 1	236	88. 6	116	69. 8
New England.....	42, 678	99. 7	41, 678	99. 8	961	94. 4	39	53. 8
White.....	41, 759	99. 7	40, 777	99. 8	946	94. 3	36	58. 3
Nonwhite.....	919	99. 3	901	99. 7	15	100. 0	3	0
Middle Atlantic.....	132, 231	99. 4	127, 154	99. 7	4, 682	97. 2	395	53. 7
White.....	122, 009	99. 5	117, 601	99. 7	4, 079	97. 5	329	52. 6
Nonwhite.....	10, 222	98. 2	9, 553	98. 7	603	95. 0	66	59. 1
East North Central.....	155, 825	99. 0	147, 554	99. 5	7, 562	92. 9	709	51. 3
White.....	144, 731	99. 1	138, 395	99. 6	5, 821	93. 0	515	45. 6
Nonwhite.....	11, 094	97. 1	9, 159	98. 6	1, 741	92. 4	194	66. 5
West North Central.....	74, 356	99. 0	69, 294	99. 7	4, 409	93. 6	653	68. 5
White.....	71, 117	99. 2	66, 627	99. 7	4, 070	93. 9	420	70. 5
Nonwhite.....	3, 239	95. 7	2, 667	99. 1	339	90. 6	233	64. 8
South Atlantic.....	119, 497	95. 6	83, 884	98. 7	17, 983	89. 0	17, 630	87. 7
White.....	84, 060	97. 2	70, 923	99. 0	10, 759	90. 3	2, 378	74. 3
Nonwhite.....	35, 437	92. 0	12, 961	97. 4	7, 224	87. 0	15, 252	89. 8
East South Central.....	68, 880	96. 2	41, 042	99. 3	14, 705	91. 5	13, 133	91. 8
White.....	48, 738	96. 5	35, 459	99. 4	10, 462	91. 7	2, 817	78. 9
Nonwhite.....	20, 142	95. 4	5, 583	98. 9	4, 243	91. 1	10, 316	95. 3
West South Central.....	81, 105	94. 8	62, 122	98. 7	9, 283	85. 2	9, 700	79. 3
White.....	63, 822	96. 6	53, 397	98. 9	6, 800	87. 7	3, 625	79. 1
Nonwhite.....	17, 283	88. 3	8, 725	97. 3	2, 483	78. 2	6, 075	79. 4
Mountain.....	31, 032	96. 6	28, 083	98. 9	1, 446	89. 8	1, 503	59. 9
White.....	29, 055	97. 9	26, 729	99. 2	1, 372	89. 9	954	72. 7
Nonwhite.....	1, 977	78. 0	1, 354	93. 9	74	87. 8	549	37. 5
Pacific.....	74, 739	99. 1	73, 410	99. 5	828	93. 5	501	52. 3
White.....	69, 502	99. 2	68, 421	99. 5	672	93. 9	409	51. 1
Nonwhite.....	5, 237	98. 1	4, 989	99. 1	156	91. 7	92	57. 6

NOTE. Registration completeness measured by percent infant cards matched.

Figure 3. Percent completeness of birth registration, 1940 test.



Improvement Among the States

Birth registration improved in virtually every State during the 1940's. States varied in completeness from 76 percent to over 99 percent in 1940, but by 1950 the range was cut in half. To the ranks of the three States that had 99 percent or higher registration completeness in the earlier period were added 20 States and the District of Columbia (fig. 3).

Large gains were made in most of the southern States, nearly all of which were well below the 90-percent point in 1940. Tennessee, with only 80 percent in that year, improved by 20 percent; Arkansas, Georgia, and South Carolina, by 15 to 16 percent; and Alabama, Louisiana, North Carolina, Oklahoma, and Texas, by at least 10 percent.

In all States, the increase in the proportion of births occurring in hospitals was an important factor in the change. However, for some States, particularly those in the South, this by no means tells the whole story. In a few, registration of hospital births during 1940 lagged substantially behind the national average. The

improvement that followed brought these areas much closer to the United States figure.

Promotional efforts among midwives and prospective parents also played a large role in the advance made in registration completeness in the southern States. These took varied forms, but in most cases they were linked to public health programs. For example, training sessions organized in a number of States under the direction of public health nurses to teach midwives maternity care were used to instruct them on the preparation of certificates.

In Alabama, Louisiana, Mississippi, and South Carolina, attendance at prenatal clinics served as a point of contact with expectant mothers to establish a check on the filing of a birth record. Post cards were given to these women with the request that they be completed and returned to the health department as soon as possible after the birth of the child. Information received in this way was then used to find out whether the attendant had registered the birth, and follow-up action was taken to remedy omissions of registration. Other steps taken by States included such measures as the

Table 3. Registration completeness by race and person in attendance at birth for selected States, 1950

[Figures for area in which birth occurred. Data preliminary, based on births in January-March 1950. States selected have less than 90 percent of births occurring in hospitals]

Area and race	Total		Physician in hospital		Physician not in hospital		Midwife, other, and not specified	
	Total infant cards	Percent matched	Total infant cards	Percent matched	Total infant cards	Percent matched	Total infant cards	Percent matched
Alabama.....	18,760	95.9	10,720	99.6	3,582	89.0	4,458	92.5
White.....	11,501	97.1	8,730	99.7	2,298	90.0	473	83.3
Nonwhite.....	7,259	94.0	1,990	99.1	1,284	87.3	3,985	93.6
Arizona.....	4,707	92.1	4,045	98.5	182	84.6	480	41.5
White.....	3,807	97.5	3,492	99.1	156	87.2	159	73.0
Nonwhite.....	900	69.6	553	94.9	26	69.2	321	25.9
Arkansas.....	11,113	88.1	6,560	97.2	2,332	78.0	2,221	71.9
White.....	7,916	92.3	5,973	97.8	1,572	81.4	371	49.9
Nonwhite.....	3,197	77.9	587	91.7	760	71.1	1,850	76.3
Florida.....	13,547	97.5	10,437	99.2	1,043	92.4	2,067	91.4
White.....	9,757	98.8	9,010	99.4	531	94.4	216	85.6
Nonwhite.....	3,790	94.1	1,427	98.0	512	90.4	1,851	92.1
Georgia.....	20,939	94.4	13,961	98.1	2,215	81.3	4,763	89.9
White.....	12,984	96.7	11,469	98.6	1,104	83.7	411	77.6
Nonwhite.....	7,955	90.8	2,492	95.6	1,111	78.9	4,352	91.0
Kentucky.....	17,208	94.7	10,721	98.5	5,008	91.1	1,479	79.3
White.....	16,052	94.7	10,140	98.5	4,504	91.0	1,408	78.9
Nonwhite.....	1,156	94.8	581	98.3	504	91.9	71	87.3
Louisiana.....	16,180	95.5	12,898	98.4	1,004	83.3	2,278	84.5
White.....	9,768	97.0	8,925	98.6	578	84.3	265	68.7
Nonwhite.....	6,412	93.3	3,973	97.9	426	81.9	2,013	86.6
Maryland.....	10,809	99.1	9,459	99.7	921	97.1	429	88.8
White.....	8,614	99.3	7,940	99.8	558	97.7	116	73.3
Nonwhite.....	2,195	98.2	1,519	99.4	363	96.1	313	94.6
Mississippi.....	14,436	97.8	6,395	99.6	2,644	95.2	5,397	97.0
White.....	6,267	98.6	5,054	99.8	1,020	94.4	193	88.6
Nonwhite.....	8,169	97.2	1,341	98.9	1,624	95.8	5,204	97.3
Missouri.....	19,176	97.9	16,230	99.3	2,596	93.0	350	70.6
White.....	17,325	98.1	14,746	99.3	2,362	93.0	217	67.3
Nonwhite.....	1,851	96.5	1,484	98.9	234	92.7	133	75.9
New Mexico.....	4,500	94.1	3,237	97.6	566	92.0	697	79.5
White.....	4,100	96.6	3,015	98.8	553	92.0	532	89.1
Nonwhite.....	400	68.3	222	81.5	13	92.3	165	48.5
North Carolina.....	23,925	96.1	16,334	98.4	4,277	91.9	3,314	90.2
White.....	16,050	97.5	13,690	98.7	1,951	92.3	409	84.6
Nonwhite.....	7,875	93.1	2,644	96.9	2,326	91.6	2,905	91.0
Oklahoma.....	11,186	96.0	9,243	99.1	1,433	87.0	510	64.5
White.....	9,803	97.3	8,493	99.2	1,151	89.7	159	55.3
Nonwhite.....	1,383	86.2	750	98.4	282	75.5	351	68.7
South Carolina.....	13,681	89.5	7,121	96.8	2,536	79.5	4,024	82.9
White.....	7,238	93.5	5,948	97.1	1,065	79.5	225	62.7
Nonwhite.....	6,443	85.0	1,173	95.0	1,471	79.5	3,799	84.1
Tennessee.....	18,476	96.7	13,206	99.5	3,471	91.9	1,799	84.8
White.....	14,918	97.2	11,535	99.6	2,640	93.4	743	73.6
Nonwhite.....	3,558	94.4	1,671	99.0	831	87.4	1,056	92.7
Texas.....	42,626	96.0	33,421	98.9	4,514	88.7	4,691	81.8
White.....	36,335	97.2	30,006	99.1	3,499	90.4	2,830	85.2
Nonwhite.....	6,291	88.9	3,415	97.3	1,015	82.7	1,861	76.7
Virginia.....	17,299	97.1	12,137	99.5	2,812	91.8	2,350	91.2
White.....	12,967	97.8	10,554	99.6	1,979	92.5	434	79.3
Nonwhite.....	4,332	95.0	1,583	99.0	833	90.2	1,916	93.9
West Virginia.....	11,756	94.2	7,131	98.5	4,035	91.3	590	62.4
White.....	10,984	94.5	6,922	98.5	3,511	91.6	551	61.3
Nonwhite.....	772	90.9	209	98.1	524	89.1	39	76.9
Alaska.....	1,010	92.1	720	98.3	18	88.9	272	75.7
White.....	567	98.4	554	98.9	3	100.0	10	70.0
Nonwhite.....	443	84.0	166	96.4	15	86.7	262	76.0

NOTE. Registration completeness measured by percent infant cards matched.

dual registration system in Georgia which requires both the parent and the attendant to report the birth.

While registration completeness of births at home increased throughout the South, decreases occurred in almost all other parts of the country. Some of the decreases were small and could be ascribed to random factors. In several States the test figures indicate a substantial decline, but a much higher proportion of the home deliveries in these areas were attended by nonphysicians in 1950 than 10 years earlier. As previously mentioned, nonphysicians in most of the areas outside the South have infrequent contact with the registration system and generally know very little about filing a birth record.

Improvement by Race

Registration in the nonwhite races improved considerably during the 1940 decade. As a result, the wide difference in registration completeness between the white and the nonwhite group that existed in 1940 was substantially reduced. From 82.0 percent in that year, the proportion of nonwhite infants for whom certificates were being filed rose to 93.4 percent in 1950. The corresponding change for the white group was from 94.0 to 98.5 percent (table 4).

In the white group, the improvement in registration was related to the more frequent use of hospital facilities in 1950. Registration of hospital births, already very high in 1940, approached even closer to 100 percent. There was practically no change in the completeness of registration of "out of hospital" births. But, in the 1950 test, 92 percent of the white births occurred in hospitals as against 56 percent in the earlier test.

On the other hand, nonwhite registration improved by 2 percent for hospital births and by 14 percent for births delivered at home. The importance of the latter improvement is indicated by the fact that even in 1950, nearly half of the nonwhite births occurred at home. Promotional efforts of many of the southern States were directed primarily toward this group.

The figures on registration of Negro births and the reasons for the improvement between 1940 and 1950 are practically identical with those for the total nonwhite group (table 5). Among the Indian births, registration completeness advanced from the very low point of 68 to 85 percent (5). The more frequent occurrence of births in hospitals in 1950 was, of course, partly responsible. A number of special administrative and procedural actions taken by the States during the decade to reduce under-registration in this race group also contributed to the change.

Table 4. Percent birth registration completeness by race for each State, Territory, and possession, 1940 and 1950

[Figures for area in which birth occurred. Data for 1950, preliminary; for 1940, final]

Area	White			Nonwhite		
	1950	1940	Percent change ¹	1950	1940	Percent change ¹
Continental United States.....	98.5	94.0	4.8	93.4	82.0	13.9
New England.....	99.7	98.6	1.1	99.3	96.9	2.5
Maine.....	98.8	96.3	2.6	² 100.0	(2)	(4)
New Hampshire.....	99.7	98.6	1.1	(2)	(2)	(4)
Vermont.....	99.4	97.3	2.2	(2)	(2)	(4)
Massachusetts.....	99.8	98.9	.9	98.7	98.0	.7
Rhode Island.....	99.9	98.8	1.1	² 100.0	² 100.0	0
Connecticut.....	100.0	99.4	.6	100.0	97.9	2.1
Middle Atlantic.....	99.5	98.2	1.3	98.2	95.4	2.9
New York.....	99.6	98.8	.8	98.4	96.3	2.2
New Jersey.....	99.7	99.0	.7	98.1	98.7	-.6
Pennsylvania.....	99.4	97.2	2.3	98.0	92.9	5.5

See footnotes to table 1. Table 4 continued on p. 522.

Table 4. Percent birth registration completeness by race for each State, Territory, and possession, 1940 and 1950—Continued

[Figures for area in which births occurred. Data for 1950, preliminary; for 1940, final]

Area	White			Nonwhite		
	1950	1940	Percent change ¹	1950	1940	Percent change ¹
East North Central.....	99.1	96.8	2.4	97.1	92.8	4.6
Ohio.....	99.0	95.3	3.9	98.0	93.7	4.6
Indiana.....	99.0	96.6	2.5	98.5	94.0	4.8
Illinois.....	99.2	97.3	2.0	96.6	90.6	6.6
Michigan.....	98.9	97.9	1.0	96.1	94.0	2.2
Wisconsin.....	99.6	96.9	2.8	98.7	93.2	5.9
West North Central.....	99.2	95.1	4.3	95.7	86.1	11.1
Minnesota.....	99.9	99.3	.6	96.8	97.2	-.4
Iowa.....	99.3	94.7	4.9	98.1	² 90.1	8.9
Missouri.....	98.1	90.7	8.2	96.5	82.7	16.7
North Dakota.....	99.4	94.6	5.1	95.7	95.2	.5
South Dakota.....	99.2	96.6	2.7	82.7	79.8	3.6
Nebraska.....	99.6	97.0	2.7	96.7	93.1	3.9
Kansas.....	99.4	95.6	4.0	96.5	92.9	3.9
South Atlantic.....	97.2	89.0	9.2	92.0	81.4	13.0
Delaware.....	99.5	97.2	2.4	98.0	98.6	-.6
Maryland.....	99.3	97.8	1.5	98.2	94.1	4.4
District of Columbia.....	99.8	98.5	1.3	97.4	96.6	.8
Virginia.....	97.8	92.5	5.7	95.0	90.2	5.3
West Virginia.....	94.5	86.7	9.0	90.9	81.3	11.8
North Carolina.....	97.5	88.4	10.3	93.1	81.0	14.9
South Carolina.....	93.5	82.7	13.1	85.0	71.8	18.4
Georgia.....	96.7	83.6	15.7	90.8	77.6	17.0
Florida.....	98.8	91.3	8.2	94.1	86.4	8.9
East South Central.....	96.5	86.9	11.0	95.4	83.1	14.8
Kentucky.....	94.7	89.2	6.2	94.8	87.6	8.2
Tennessee.....	97.2	81.4	19.4	94.4	75.1	25.7
Alabama.....	97.1	86.4	12.4	94.0	82.4	14.1
Mississippi.....	98.6	93.8	5.1	97.2	86.2	12.8
West South Central.....	96.6	87.1	10.9	88.3	73.3	20.5
Arkansas.....	92.3	79.6	16.0	77.9	63.2	23.3
Louisiana.....	97.0	87.7	10.6	93.3	83.7	11.5
Oklahoma.....	97.3	87.0	11.8	86.2	66.9	28.8
Texas.....	97.2	89.3	8.8	88.9	68.7	29.4
Mountain.....	97.9	93.7	4.5	78.0	56.2	38.8
Montana.....	99.5	98.0	1.5	98.9	91.1	8.6
Idaho.....	98.5	95.1	3.6	² 98.0	² 79.3	23.6
Wyoming.....	98.8	95.9	3.0	² 100.0	² 85.4	17.1
Colorado.....	96.7	89.8	7.7	97.7	² 90.4	8.1
New Mexico.....	96.6	91.2	5.9	68.3	40.3	69.5
Arizona.....	97.5	93.8	3.9	69.6	48.4	43.8
Utah.....	99.1	97.1	2.1	² 82.5	² 59.6	38.4
Nevada.....	98.8	97.5	1.3	² 88.6	² 80.9	9.5
Pacific.....	99.2	98.0	1.2	98.1	94.9	3.4
Washington.....	99.2	98.0	1.2	96.3	88.7	8.6
Oregon.....	99.1	97.3	1.8	99.4	² 84.1	18.2
California.....	99.2	98.1	1.1	98.3	96.5	1.9
Territories and possessions:						
Alaska.....	98.4	(³)	(³)	84.0	(³)	(³)
Hawaii.....	99.8	(³)	(³)	99.9	(³)	(³)
Puerto Rico.....	(³)	(³)	(³)	(³)	(³)	(³)
Virgin Islands.....	(³)	(³)	(³)	100.0	(³)	(³)

See footnotes to table 1.

Methodology

The 1950 birth registration test was limited to infants born during the 3-month period, January 1 through March 31, 1950. Two sets of independently collected records for these infants were compared to obtain measures of registration completeness, that is, birth records on file were matched against infant cards filled out by Census enumerators during the Decennial Census of Population and Housing in April 1950, for enumerated children born in the first 3 months of the year. Because of the confidential nature of the infant cards, they were handled only by Census personnel or special agents of the Bureau of the Census (for discussion of methodology in the 1940 test, see reference 2).

The matching operation consisted of three major phases.

1. *Matching at the National Office of Vital Statistics.* A punched card containing alphabetical and statistical data was prepared by the National Office of Vital Statistics for each birth record and infant card in the test. The punched cards were collated mechanically using various combinations of common identifying information. When data on these cards were inadequate to establish a match, copies of the original records were examined for confirming evidence.

About 94 percent of the 780,000 infant cards in the test were matched during these operations. (The 780,000 cards do not represent the exact number of infants enumerated in the census since in some cases the enumerator recorded the child on the basic population schedule but failed to fill out an infant card.)

2. *Mail survey.* Unmatched infant cards were included in a mail survey designed to verify and correct information on the residual group. The questionnaire was sent to parents and in special cases to welfare organizations and hospitals. Replies to the initial mailing and follow-up letter were received for about 80 percent of the records. These responses resulted in additional matches and in the elimination of infant cards for children born outside the test period.

3. *State searches.* The 30,000 infant cards still unmatched after the mail survey were sent to State, independent city, and Territorial registration offices for searches against their files. Registrars were authorized to use other sources of information within the limitations of Census and State regulations. Matching records were located for almost half the infant cards sent to these offices. Problems of identification created by illegitimacy, adoption, and other situations resulting in name changes were frequently resolved in this phase.

Preliminary Nature of Test Results

All figures now being released for the 1950 test are preliminary. Final results will become available in a few months after States have had an additional opportunity to search their files and contact agencies in a final effort to locate matching birth records. However, changes in preliminary results are expected to be very small in virtually all States. Final tabulations currently planned will make available completeness data for urban and rural residents and for various demographic charac-

Table 5. Percent birth registration completeness by specified race, 1940 and 1950, and by person in attendance, 1950, continental United States

[Data for 1950, preliminary; for 1940, final]

Person in attendance and year	All races	White	Negro	Indian	Other races
Total:					
1950.....	97.8	98.5	93.6	85.0	97.4
1940.....	92.5	94.0	81.9	68.3	97.8
Percent change.....	+5.7	+4.8	+14.3	+24.5	-.4
Person in attendance 1950:					
Physician in hospital.....	99.4	99.5	98.2	96.6	99.1
Physician not in hospital.....	90.6	91.7	87.6	90.9	88.6
Midwife, other, and not specified.....	84.5	73.9	89.4	44.4	69.8

teristics, including age and education of the mother, birth order, and occupation of the father.

REFERENCES

- (1) Shapiro, Sam: Development of birth registration and birth statistics in the United States. *Population Studies* 4: 86-111 (1950).
- (2) Grove, Robert D.: Studies in completeness of birth registration. Part I. Completeness of birth registration in the United States, December 1, 1939 to March 31, 1940. U. S. Bureau of the Census. *Vital Statistics—Special Reports*, vol. 17, No. 18. Washington, D. C., 1943.
- (3) Moriyama, Iwao M.: Estimated completeness of birth registration, United States, 1935 to 1944. U. S. Bureau of the Census. *Vital Statistics—Special Reports*, vol. 23, No. 10. Washington, D. C., 1946.
- (4) Tuthill, Dorothy D.: Completeness of registration of births occurring in institutions and of births not occurring in institutions: United States, December 1, 1939 to March 31, 1940. U. S. Bureau of the Census. *Vital Statistics—Special Reports*, vol. 23, No. 8. Washington, D. C., 1946.
- (5) Hadley, J. Nixon: Registration of vital events among Indians. U. S. National Office of Vital Statistics. *Vital Statistics—Special Reports*, vol. 33, No. 6. Washington, D. C., 1950.



Poliomyelitis in the United States, 1951

By C. C. DAUER, M.D.

A decrease of approximately 15 percent in both the incidence of poliomyelitis and its estimated death rate in the United States in 1951 is indicated by comparison of provisional data with 1950 figures. Five thousand fewer cases were reported than in 1950, and the estimated death rate, based on a 10-percent sample, was 0.9 per 100,000 population as compared with 1.1 for 1950. (Comparative data for 1946-51 are given in table 1.)

The distribution of poliomyelitis cases by counties in 1951 is shown on the map. The largest area of relatively high incidence was centered in the Colorado-Utah-Wyoming tri-

angle, but it also included portions of adjacent States. In 1950, the area of highest incidence was adjacent to and east of this area.

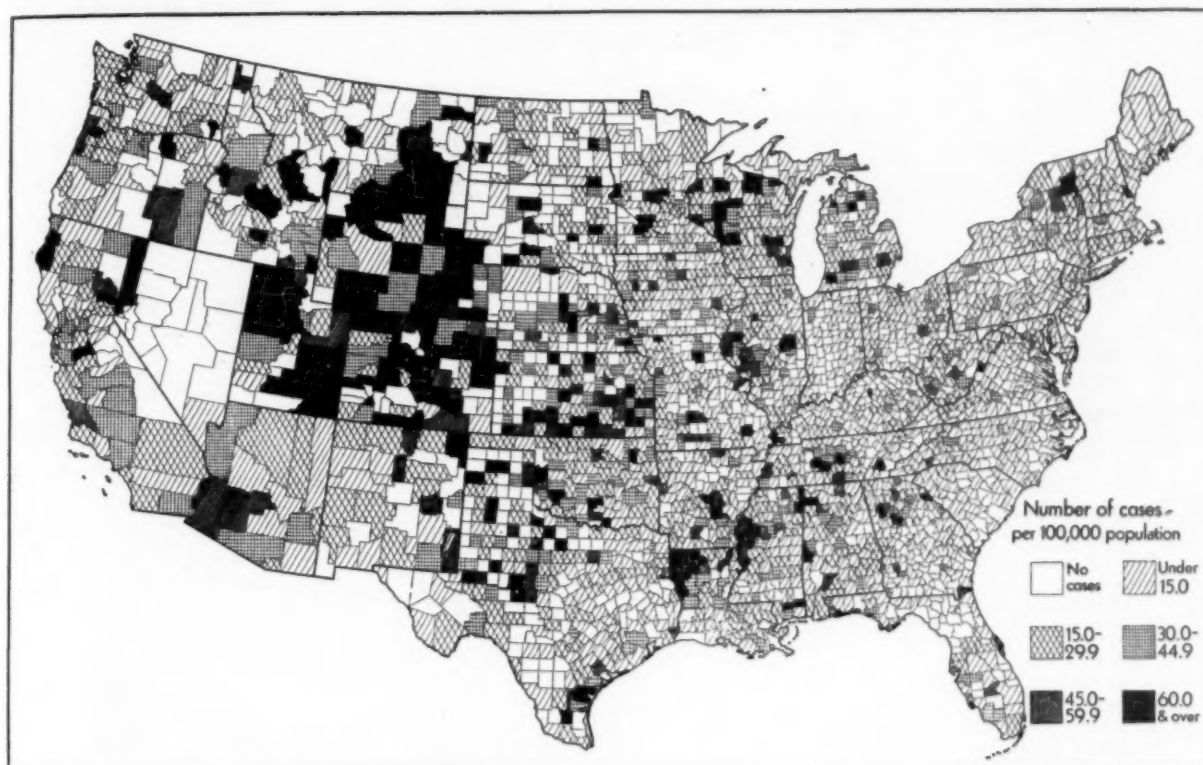
There were smaller areas of epidemicity in southeast Kansas, Wisconsin, Illinois, Missis-

Table 1. Poliomyelitis morbidity and mortality in the United States, 1946-51

Year	Number cases reported	Case rate per 100,000 population	Number deaths	Death rate per 100,000 population
1946-----	25,698	18.4	1,845	1.3
1947-----	10,827	7.6	580	.4
1948-----	27,726	19.0	1,895	1.3
1949-----	42,033	28.3	2,720	1.8
1950-----	33,303	22.0	-----	¹ 1.1
1951-----	² 28,395	18.8	-----	¹ .9

¹ Rate based on 10-percent sample of deaths. ² Provisional figures.

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Distribution of poliomyelitis in the United States, 1951.

issippi, Louisiana, Georgia, Tennessee, and Texas. In some counties in these areas the incidence rates were comparable to those found in a few counties in the larger area.

The county having the highest incidence rate was Pueblo County, Colo.; 280 cases were reported and the rate was 310 per 100,000 population. Sunflower County, Miss., reported 148 cases, with a rate of 264; Sawyer County, Wis., reported 26 cases, with a rate of 252. Several counties in the northwestern part of Louisiana had incidence rates varying from 107 to 225 cases per 100,000 population. These rates, however, were all well below the 1950 rate of 810 in Wythe County, Va.

Cases of poliomyelitis had been reported in all the counties mentioned above in several of the years immediately prior to 1951 and in some of the counties in each of the 5 years from 1946 to 1950. Thus, relatively high rates of incidence of the disease may occur in a small area, such as a county, where the infection has been present in recognizable form in the years immediately prior to the epidemic period.

The 1951 incidence rates of poliomyelitis for the various States ranged from about 2 cases per 100,000 population in Rhode Island to 84 in Utah (see table 2). The median rate for the 48 States and the District of Columbia was 18.8, which was also the incidence rate for the United States as a whole.

Utah, Colorado, and Wyoming, the center of the largest epidemic area, were the three States having the highest incidence rates. Although relatively high, the rates in these States were much below the rates for Minnesota (117.3) in 1946 and South Dakota (150.6) in 1948, and slightly less than the rate for Idaho in 1949. Colorado had relatively high rates in 2 of the 5 years immediately preceding 1951, 75.9 in 1946 and 53.5 in 1949. In both Utah and Wyoming incidence rates were moderately high in 3 of the 5 years.

Included in the five States having the highest incidence rates in 1951 was Wisconsin, in the East North Central section, and Kansas, in the West North Central section.

Table 2. Poliomyelitis cases reported in 1951 and morbidity rates per 100,000 population, 1946-51, by States

	Number cases reported, 1951 ¹	Morbidity rates					
		1951 ¹	1950	1949	1948	1947	1946
New England:							
Maine.....	48	5.2	10.1	49.3	4.4	5.0	4.7
New Hampshire.....	55	10.3	7.1	47.2	4.7	6.2	38.3
Vermont.....	32	8.4	9.2	39.2	7.3	11.6	21.1
Massachusetts.....	293	6.2	11.0	37.3	3.7	7.5	8.5
Rhode Island.....	15	1.9	7.0	19.8	1.0	17.9	12.0
Connecticut.....	300	14.9	23.7	32.6	6.1	6.7	6.4
Middle Atlantic:							
New York.....	1,645	11.0	27.1	34.4	9.5	8.2	10.1
New Jersey.....	449	9.2	17.8	31.6	17.4	6.6	5.8
Pennsylvania.....	797	7.6	13.6	9.1	8.0	5.3	3.5
East North Central:							
Ohio.....	1,142	14.3	23.0	22.5	14.5	19.1	9.6
Indiana.....	370	9.4	15.1	29.4	10.0	6.9	12.4
Illinois.....	1,695	19.4	22.2	33.7	13.0	10.4	31.3
Michigan.....	1,470	23.0	31.7	46.4	12.6	10.7	18.6
Wisconsin.....	1,393	40.4	25.2	35.1	18.8	6.4	40.5
West North Central:							
Minnesota.....	613	20.4	19.5	64.9	50.6	8.9	117.3
Iowa.....	449	17.0	53.1	47.7	49.7	7.2	26.6
Missouri.....	717	18.1	10.4	33.8	8.3	3.4	34.1
North Dakota.....	93	14.9	6.7	77.4	23.1	15.2	90.9
South Dakota.....	132	20.0	29.1	65.7	150.6	4.6	68.7
Nebraska.....	436	32.6	34.2	53.0	57.7	17.0	52.6
Kansas.....	794	41.4	27.0	39.0	18.3	5.2	61.0
South Atlantic:							
Delaware.....	14	4.4	12.5	14.4	40.4	37.1	10.7
Maryland.....	149	6.3	30.0	13.5	8.0	6.8	5.6
District of Columbia.....	66	8.4	23.3	12.6	15.5	2.5	3.9
Virginia.....	267	8.1	36.2	10.2	17.4	5.4	4.5
West Virginia.....	299	14.9	18.7	17.7	9.4	7.7	4.2
North Carolina.....	326	8.0	18.5	5.8	65.6	8.0	4.3
South Carolina.....	125	5.9	20.3	5.5	19.4	3.4	1.1
Georgia.....	639	18.5	13.8	6.8	7.0	2.7	5.1
Florida.....	362	13.0	16.9	10.5	10.9	4.4	23.5
East South Central:							
Kentucky.....	339	11.5	23.4	24.0	7.1	4.4	4.2
Tennessee.....	701	21.3	17.0	16.7	11.6	5.4	6.0
Alabama.....	695	22.7	9.2	8.1	6.9	1.7	13.0
Mississippi.....	728	33.3	18.0	17.3	8.0	2.7	17.0
West South Central:							
Arkansas.....	462	24.2	17.6	54.1	8.1	4.6	23.2
Louisiana.....	836	31.1	15.2	8.6	6.3	2.1	14.9
Oklahoma.....	651	29.2	23.9	62.1	17.5	2.7	20.3
Texas.....	2,029	26.3	36.0	20.7	23.3	2.5	13.7
Mountain:							
Montana.....	139	23.2	8.0	15.7	12.1	5.2	26.1
Idaho.....	144	24.3	27.2	89.2	22.1	71.2	9.4
Wyoming.....	212	72.9	16.2	43.5	30.5	7.0	47.1
Colorado.....	1,072	80.1	15.3	53.5	10.5	5.5	75.9
New Mexico.....	148	21.4	19.4	31.0	13.3	7.0	29.9
Arizona.....	296	39.3	22.3	24.7	24.2	5.5	22.8
Utah.....	584	84.0	11.7	41.9	31.1	4.3	22.8
Nevada.....	47	29.4	15.6	15.7	13.8	5.2	11.0
Pacific:							
Washington.....	447	18.8	26.7	24.9	16.6	7.4	22.2
Oregon.....	368	24.1	34.1	21.8	14.8	7.6	11.1
California.....	3,312	31.3	20.9	26.1	55.2	8.5	22.1

¹ Provisional.

Patient Load and Volume of Medical Services

By ANTONIO CIOCCO, Sc.D., ISIDORE ALTMAN, M.S., and T. DAVID TRUAN, M.A.

Measurement of the volume of medical services received by the population is needed in appraising the extent to which the demand for medical services is related to the supply of physicians. This measurement is important in a comprehensive study of the distribution of physicians whether our concern is with the general problem of geographic maldistribution or with the particular problem of apportionment of available manpower between the civilian population and the armed forces.

Previous studies (1-6) have shown that the size of the patient load is a useful index for gauging the degree to which physicians are able to meet the demand for medical services. But, significantly, they revealed that physicians vary markedly in the amount of services they give. Some of this variation is due to place of practice and to specialty, some to the characteristics of the individual physician. Because of this variation, the relative number of physicians in a population cannot measure, except crudely perhaps, the amount of medical services available to that population.

For this reason we have inquired further into the factors which are related to the size of the patient load and its variation. In a study of the weekly patient load of physicians in active private practice in western Pennsylvania, we have explored the relationship between patient

load, supply of physicians, and volume of services with the intent of showing how much the volume depends on the first two factors.

The study compares the patient load of physicians in western Pennsylvania with findings in other places. It translates the patient load into volume of services and adjusts this volume for the intercounty movement of population to obtain medical services. Neither the patient load nor the ratio of physicians to population can substitute for the volume of services as an indication of the relationship between supply and demand, yet information about both is needed in order to arrive at such a measure.

Material and Method

The data are derived from a study of health manpower requirements undertaken for the National Security Resources Board by the Public Health Service and the Graduate School of Public Health, University of Pittsburgh.

On October 10, 1950, a questionnaire was mailed to every physician in the 29 western-most counties of Pennsylvania. This questionnaire requested, among other items, information on the number of patients (different individuals) seen during one week in office, home of patient, and hospital. Table 1 shows the distribution by county of the replies from active practitioners. While 40 percent of all the physicians replied, only 34 percent of the active private physicians did so. Variation among the counties was considerable. Two counties, Cameron and Forest, each with four physicians, none of whom replied, have been omitted from this analysis. Among the remainder, the percentage of replies varied from 15 in Elk to 50 in Jefferson County and almost 50 among 100

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physicians in Mercer County. In Allegheny County, where nearly half of the study area's physicians are concentrated, 39 percent replied.

Table 1. Distribution by county of all active private practitioners and those replying to questionnaire

County	Population 1950	Active private practitioners		Replies	
		Number	Per 100,000 population	Number	Percent
Allegheny	1, 515, 237	1, 608	106	629	39. 1
Armstrong	80, 842	46	57	13	28. 3
Beaver	175, 192	139	79	41	29. 5
Bedford	40, 775	18	44	5	27. 8
Blair	139, 514	111	80	29	26. 1
Butler	97, 320	72	74	27	38. 5
Cambria	209, 541	166	79	54	32. 5
Cameron	7, 023	4	57	0	0
Centre	65, 922	45	68	12	26. 7
Clarion	38, 344	31	81	9	29. 0
Clearfield	85, 957	45	52	16	35. 6
Clinton	36, 532	26	71	6	23. 1
Crawford	78, 948	64	81	10	15. 6
Elk	34, 503	27	78	4	14. 8
Erie	219, 388	211	96	64	30. 3
Fayette	189, 899	133	70	24	18. 0
Forest	4, 944	4	81	0	0
Greene	45, 394	34	75	8	23. 5
Indiana	77, 106	47	61	15	31. 9
Jefferson	49, 147	40	81	20	50. 0
Lawrence	105, 120	84	80	26	31. 0
McKean	56, 607	58	102	17	29. 3
Mercer	111, 954	100	89	48	48. 0
Potter	16, 810	14	83	4	28. 6
Somerset	81, 813	45	55	9	20. 0
Venango	65, 328	50	77	18	36. 0
Warren	42, 698	41	96	15	36. 6
Washington	209, 628	159	76	47	29. 6
Westmoreland	313, 179	247	79	61	24. 7
Total	4, 194, 665	3, 669	87	1, 231	33. 6

Comparison of the age distribution of those who replied with that of all the active private practitioners in the area (table 2) shows the two distributions to be similar. As has been found in other studies, the younger men showed a greater disposition to reply. The distribution of specialties among those who replied is also similar to that of the total (table 3). More complete returns would have strengthened the conclusions coming out of this analysis. However, in view of the representative character of the replying physicians—at least with respect to age and specialty—the proportion of questionnaires returned appears adequate. Fur-

thermore, the findings are consistent with those observed elsewhere.

Weekly Patient Load of General Practitioners

The average weekly patient loads (different individuals) of general practitioners in western Pennsylvania and the results of previous studies are shown in table 4. Part-specialists, those who are interested in, but do not limit their practices exclusively to, a special field of medicine, are included here as general practitioners.

Because of differences found elsewhere between rural and urban physicians, the data for Pennsylvania are grouped as follows in order to arrive at some approximation here of rural-urban differences: Pittsburgh, Allegheny County (including Pittsburgh), other metropolitan counties, and other counties. The other metropolitan counties consist of the four counties in the study area—Blair, Cambria, Erie, and Lawrence—which contain cities of 50,000 persons or more. The other counties are the remaining 22 in this study.

General practitioners in this area saw an average of 107 patients during the study week, 83 in the office, 8 in the hospital, and 16 in the patient's home. Pittsburgh and other Allegheny County physicians reported a lower average patient load than did the physicians in the remainder of the area. This agrees with previous findings that general practitioners in predominately urban areas have a lower patient load than those practicing in more rural places. In the present instance, the difference in totals is largely accounted for by the differences in number of patients seen in the office.

The patient load for all general practitioners in Pennsylvania is about the same as that observed in Georgia in December 1942, and somewhat lower than was found in the District of Columbia in September 1942 and in Maryland in October 1942. However, these three studies were made about a year after the United States entered World War II, when almost a quarter of the physicians in active private practice had been drawn into the armed forces (7). The present patient load in western Pennsylvania is appreciably higher than it was in the District of Columbia in June 1947. Then, in the Dis-

Table 2. Age distribution of all active private practitioners and of those replying to questionnaire

Age in years	Number of physicians		Percentage distribution	
	All	Replying	All	Replying
Under 35-----	534	197	14.5	16.0
35-44-----	1,083	414	29.5	33.6
45-54-----	795	282	21.7	22.9
55-64-----	532	173	14.5	14.1
65 and over----	715	163	19.5	13.2
Unknown-----	10	2	.3	.2
Total-----	3,669	1,231	100.0	100.0

Table 3. Distribution by specialty of all active private practitioners and of those replying to questionnaire

Specialty	Number of physicians		Percentage distribution	
	All	Replying	All	Replying
General practice----	2,463	748	67.1	60.8
Surgery-----	296	108	8.0	8.8
Obstetrics and gynecology-----	109	55	3.0	4.5
Eye, ear, nose and throat-----	252	85	6.9	6.9
Urology and proctology-----	61	22	1.6	1.8
Dermatology-----	40	20	1.1	1.6
Internal medicine-----	223	115	6.1	9.3
Neurology and psychiatry-----	44	17	1.2	1.4
Pediatrics-----	76	34	2.1	2.7
Pathology, radiology, and anesthesiology-----	105	27	2.9	2.2
Total-----	3,669	1,231	100.0	100.0

trict, the bulk of the physicians in service had been released, including many new physicians who had been trained during the war years, and the ratio of physicians to population had returned to its prewar level. Thus, the physicians in this area apparently are nearly as busy as physicians were in three other areas after 1 year of war, and busier than physicians in post-war Washington, where the receipt of medical services is at least as high as anywhere else in the country but where the ratio of physicians to population is also very high.

The size of the standard deviations that accompany these averages reflects the wide varia-

tion in patient load among general practitioners and among all physicians. The extent of this variation is about the same here as in the other areas studied, indicating the consistency of these data with the findings elsewhere.

One of the major elements contributing to the total variation in the patient load is the variation according to age of physician. That age is a factor in size of practice has been clearly demonstrated in the earlier studies. It re-emphasizes the inadequacy of the relative number of physicians as an index of services available to the population.

In Allegheny County and in the nonmetropolitan counties, the maximum patient load is found in the age group 35-44 years, with a decrease to a minimum in the group 65 years and over (fig. 1). This is the same pattern observed in all the previous studies and is reflected in a similar pattern of income among general practitioners (8).

The findings in relation to other metropolitan counties do not follow the same pattern. In these counties, the older physicians reported as high a patient load as the younger physicians. No explanation can be offered at this time except perhaps that this pattern may be a consequence of a higher demand for services in these counties than in the other parts of the study area.

Weekly Patient Load of Specialists

As has been found in other studies, the patient load among physicians who limit their practices to special fields of medicine tends on the whole to be somewhat lower than among general practitioners, although ophthalmology and otorhinolaryngology, which are combined, and pediatrics appear to be exceptions. For these specialties and for neurology and psychiatry, the physicians in Allegheny County have a higher patient load than the same specialists in the other counties. For the other specialties the reverse is true (table 5).

Patient Load and Number of Physicians

There has been a tendency to assume that physicians must be overworked in areas where

they are scarce and that those in communities with a relatively large number of physicians have little to do. As was pointed out in an earlier paper (9), patient load is not necessarily related to the supply of physicians.

Comparison of patient load (table 6, col. 1) with the ratio of physicians to population (table 1) reveals that in general there is little association between the two items. Armstrong and Indiana Counties, for example, have ratios of 57 and 61 physicians per 100,000 population, respectively, yet the general practitioners of Armstrong County, which has fewer physicians, reported a patient load of 110 as contrasted with 145 in Indiana County. At the same time, the general practitioners in counties with more than 90 physicians per 100,000 persons—Allegheny, Erie, McKean, and Warren—reported below-average patient loads. If one can generalize from these findings, it would appear that in counties with relatively few physicians, the patient load may be large or small, while in counties with a relatively large

number of physicians, the patient load tends to be low.

The small association between patient load and relative numbers of physicians is seemingly reflected in the absence of association between patient load and per capita income in the individual counties. Low patient loads are found in both wealthy and poor counties, in the former because they tend to have a large number of physicians and in the latter because of the low demand for services. Thus, average patient load was 92 in Allegheny, the wealthiest county in the group, and 81 in Greene, one of the poorer counties.

The conclusion from these findings must be that neither patient load nor supply of physicians will alone measure the demand for medical services. The latter indicates the medical resources potentially available to the population while the former measures the degree of activity of these physicians. The two together are necessary in order to obtain a measure of services actually received and should constitute

Table 4. Average weekly patient load of general practitioners¹ by place of practice

Place of practice and date of survey	Number of physicians giving information	Average weekly patient load				Standard deviations	
		Office	Hospital	Home of patient	Total	Office	Total
Pennsylvania (October 1950):							
Pittsburgh.....	227	65	6	16	87	52	65
Allegheny County (including Pittsburgh) ..	330	67	7	17	91	52	65
Other metropolitan counties.....	109	101	9	15	125	59	69
Other counties.....	308	95	9	16	120	56	64
Total.....	747	83	8	16	107	57	67
District of Columbia:							
September 1942.....	156	86	8	21	115	78	84
June 1947.....	157	64	3	11	78	56	56
Maryland (October 1942):							
Baltimore.....	288	82	6	31	119	64	88
Exclusive of Baltimore City.....	262	96	7	29	132	71	88
Total.....	550	89	7	30	126	68	88
Georgia (December 1942):							
Urban.....	170	78	11	23	112	53	73
Rural.....	436	79	6	26	111	59	77
Total.....	606	79	7	25	111	57	76

¹ For areas other than Pennsylvania, the data refer to male white general practitioners.

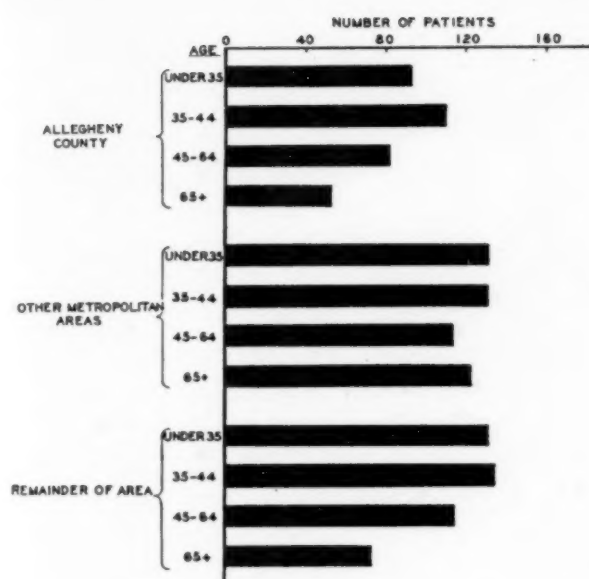


Figure 1. Patient load according to age group of physicians.

the basis for appraising the effective demand to be expected from a population.

Such a measure can be acquired directly from the consumers of medical care by interview, but this is a more costly and time-consuming method and would not be expected to yield more accurate results from a practical standpoint.

Services Per Person

An estimate of the total volume of services obtained in one week by the population can be calculated by multiplying the average patient load by the number of physicians practicing in the community. Multiplication by 50, assuming that the physician's year is composed of 50 weeks, will yield an estimate of the total number of services received in one year. For purposes of comparison among different populations, total services are best reduced to a per capita basis by dividing total volume by the size of the population (table 6, col. 2).

There is marked variation among the counties, the range in annual services per person being 2.6 to 6.4. However, in 11 of the 27 counties the annual number of services fell between 4.0 and 5.0 per person; in the majority of counties the rate was more than 4.0 services.

Similar calculations in the previous studies

show that for all of Maryland and for urban Georgia the estimated annual services per person were 4.7 and 4.9, respectively, which are close to the average of 4.4 here. As would be expected, the rates for Baltimore and the District of Columbia were much higher, 5.9 and 6.2. These high rates of services reflect two factors: (a) the greater availability of medical personnel and the higher demand that accompanies higher income and educational levels; and (b) the movement of patients for medical care toward the metropolitan centers.

This factor of movement has to be taken into account if a real understanding is to be sought of the differences between areas in the amount of medical services received. Such information is available in the present study since the physicians supplied data on place of residence of

Table 5. Average weekly patient load of physicians engaged in practice limited to special fields, by type of county

Specialty and place of practice	Number of physicians giving information	Weekly patient load	
		Average	Standard deviation
Internal medicine:			
All	115	83	63
Allegheny County	79	78	67
Other metropolitan counties	14	97	47
Other counties	22	94	63
Surgery:			
All	108	84	51
Allegheny County	60	82	45
Other metropolitan counties	16	97	63
Other counties	32	80	46
Obstetrics and gynecology:			
All	55	86	54
Allegheny County	35	87	58
Other metropolitan counties	9	80	37
Other counties	11	88	42
Pediatrics:			
All	34	99	53
Allegheny County	23	107	52
Other metropolitan counties	4	96	23
Other counties	7	73	46
Ophthalmology or otorhinolaryngology:			
All	85	112	74
Allegheny County	44	123	73
Other metropolitan counties	11	103	67
Other counties	30	100	70
Neurology and psychiatry:			
All	16	40	36
Allegheny County	13	42	36
Other metropolitan counties	2	37	5
Other counties	1	19	-----

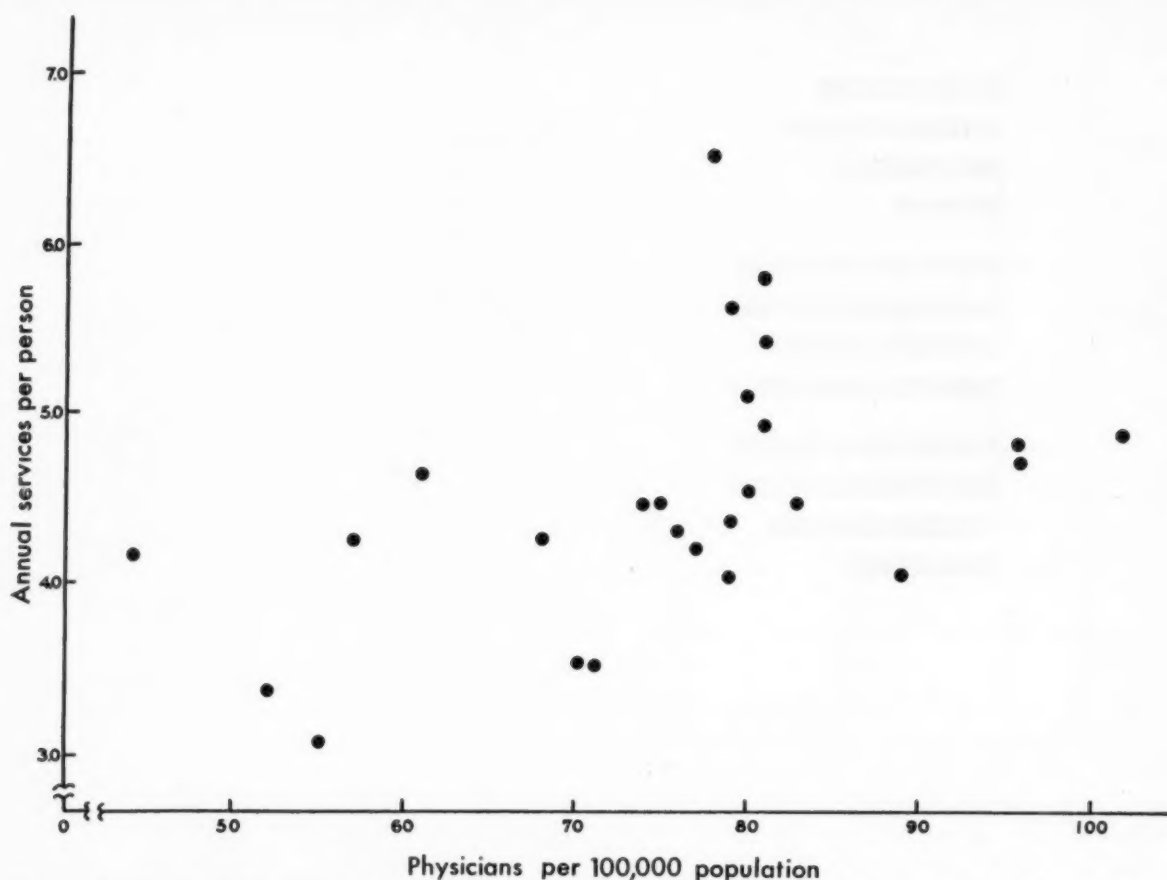


Figure 2. Scatter diagram showing adjusted services per person and ratio of physicians to population (each point represent a county).

the patients seen on one particular day. On the basis of these data, an adjustment for movement of patients from one county to another was made possible (table 6, col. 3).

The counties which contain large cities and attract patients from elsewhere show a decrease in number of services per person, while the more rural counties show an increase. The reason is that the data now apply to the residents of the respective counties. The unadjusted figure may be compared to birth and death rates by place of occurrence, while the adjusted figures are analogous to these rates by place of residence. The net result of this adjustment is to diminish the differences between counties. The great majority of counties, 18 of the 27, now show 4.0 to 5.0 services per person. Although rank order of the counties remains about the same after the adjustment, some striking changes occur in the actual rates of certain counties. For example, the rate for Armstrong

changes from 3.2 to 4.2. This marked increase is related to the extent to which the population travels to other counties, Allegheny County in particular, for medical care.

The rate, services per person, is calculated from the number of physicians and their patient load. As we have seen, there is very little association between these two. It remains now to determine how either of them or both are related to number of services per person.

Figure 2 is a scatter diagram showing adjusted services per person and ratio of physicians to population; each point represents a county. It can be seen from the figure that a tendency exists for services to increase as the ratio goes up. Where the supply of physicians is high, the number of services received per person also tends to be high. However, the scatter of the points shows that the degree of association is not sufficiently strong to permit one to assume that whenever there is a

larger supply of physicians, more services will be received by the population. Indeed, a recent study of two counties in New York State (10) demonstrated that the reverse could occur. In one county with 97 general physicians per 100,000 persons, 54 percent of a sample of residents reported a visit to the physician in the study year. The other county had 85 such physicians per 100,000 persons, yet 62 percent of the population reported at least one visit. The difference between percentages is attributed by the authors of the study largely to differences in the accessibility and geographic distribution of general physicians within the two counties. All these findings point to the limitations of the ratio of physicians to population as a measure of medical services.

An association is also found in western Pennsylvania between patient load and services per person, but the degree is even smaller.

Table 6. Average patient load of all physicians and estimated annual physician services per person, unadjusted and adjusted for intercounty movement of patients

County	Average weekly patient load	Services per person ¹	
		Unadjusted	Adjusted
Allegheny	91.7	4.63	4.41
Armstrong	110.0	3.17	4.22
Beaver	139.3	5.47	5.59
Bedford	168.4	3.52	4.17
Blair	148.1	5.01	4.51
Butler	108.2	3.85	4.43
Cambria	110.9	4.14	4.02
Centre	128.6	4.32	4.24
Clarion	128.8	5.46	5.39
Clearfield	104.6	2.68	3.37
Clinton	119.8	3.91	3.49
Crawford ²	128.6	5.37	5.75
Elk ²	146.5	6.41	6.46
Erie	103.2	4.85	4.68
Fayette	101.5	3.47	3.52
Greene	80.9	3.94	4.44
Indiana	144.8	4.41	4.61
Jefferson	130.4	5.11	4.91
Lawrence	122.0	5.16	5.07
McKean	98.7	4.87	4.82
Mercer	92.7	3.96	4.03
Potter	105.5	4.32	4.43
Somerset ²	101.9	2.59	3.07
Venango	124.5	4.42	4.19
Warren	106.2	4.66	4.77
Washington	102.7	4.06	4.28
Westmoreland	105.3	4.02	4.34

¹ Since these are based on the number of different individuals seen in one week and not on visits, they underestimate somewhat the true number of services.

² Fewer than 20 percent of the physicians reported.

To some extent both of these findings are to be expected in view of the lack of association between patient load and ratio of physicians to population. To calculate or estimate services per person, both sets of data are needed.

Summary and Discussion

The findings of this study of patient load among the physicians of 27 counties of western Pennsylvania may be summarized as follows:

1. The average weekly patient load (different individuals) of general practitioners in October 1950 was 107. The patient load was lower in Allegheny County and Pittsburgh than in the rest of the study area.

2. In general, the age pattern was the same as that observed in other studies, with peak patient load among physicians in the 35-44 age group.

3. Patient load of the individual counties was not appreciably related to per capita income or to the relative number of physicians in the county.

4. The estimated number of services per person, adjusted for the movement of patients from one county to another, was found to lie between 4.0 and 5.0 per year in the majority of counties.

5. The average number of services per person was associated with number of physicians in the county and to a lesser degree with patient load.

These findings have a bearing on several aspects of medical care problems. In the first place, they reveal that physicians, in this area at least, are as busy on the average as physicians were in several other parts of the country at the end of 1942 after a substantial number of physicians had been drawn from civilian life into the armed forces. Since no earlier data are available for the study area, we cannot say whether the work load of physicians has been increasing or not. However, a patient load nearly equivalent to that observed here was cause for anxiety among practicing physicians of the areas studied during the war. It would, therefore, appear that, by and large, the physicians in the present study area are working at nearly full capacity. To what extent this work load can be increased cannot be determined without more intensive investigation. One

item of information on this point is that in April 1945 the average weekly patient load of general practitioners in the District of Columbia had reached a peak of 133, and had become a matter of deep concern to the Medical Society of the District.

In view of the current discussions on the need for more physicians, further studies of patient load, both actual and potential, would go far to clarify the issues.

The patient load enables us to estimate the amount of physician services received by a population. It is this volume of services, rather than the number of physicians in the population, which should be used as an index of the adequacy of the amount of medical services that a population is receiving. This is important when we are considering problems of medical care generally, but it is particularly important now when we are faced with the possibility of having to withdraw large numbers of physicians from the civilian population. Under such circumstances, we must consider whether or not to decrease the services received by the civilian population, or if we wish to maintain the services at their present level, how far the number of physicians can be reduced and the patient load of the remaining physicians increased. In either instance we must know the number and kinds of these services, the number of physicians, and their patient load.

REFERENCES

- (1) Ciocco, Antonio, Pond, M. Allen, and Altman, Isidore: Survey of practicing physicians in Washington. *Med. Ann. District of Columbia* 11: 454-457 (1942).
- (2) Ciocco, Antonio, and Altman, Isidore: Statistics on the patient load of physicians in private practice. *J. A. M. A.* 121: 506-513 (1943).
- (3) Ciocco, Antonio, and Altman, Isidore: The patient load of physicians in private practice. *Pub. Health Rep.* 58: 1329-1351 (1943).
- (4) Ciocco, Antonio, and Altman, Isidore: On the decrease of practicing physicians in Washington, D. C. *Med. Ann. District of Columbia* 12: 407-411 (1943).
- (5) Ciocco, Antonio, and Altman, Isidore: Changes in the number and patient load of physicians practicing in Washington, 1942-1945. *Med. Ann. District of Columbia* 14: 223-227 (1945).
- (6) Ciocco, Antonio, and Altman, Isidore: Postwar survey of physicians practicing in Washington. *Med. Ann. District of Columbia* 16: 575-580 (1947).
- (7) U. S. Congress, Senate Committee on Education and Labor: Investigation of manpower resources: Hearings on Senate Resolution 291 77th Congress, 2d sess., 1942. Washington, D. C., U. S. Government Printing Office, 1942, 1943.
- (8) Weinfeld, William: Income of physicians, 1929-1949. *Survey of Current Business* 31: 9-26 (July 1951).
- (9) Ciocco, Antonio, Davis, Burnet M., and Altman, Isidore: Measures of medical resources and requirements. *Med. Care* 3: 314-326 (1943).
- (10) Larson, Olaf F., and Hay, Donald G.: Hypotheses for sociological research in the field of rural health. *Rural Sociol.* 16: 225-237 (1951).

Dr. McCoy, Former Director of NIH

Dr. George W. McCoy, for 22 years director of the Hygienic Laboratory (now the National Institutes of Health) of the Public Health Service died in Washington, D. C., April 2, at the age of 75.

Dr. McCoy entered the Public Health Service in 1900. He served as director of the U. S. Plague Laboratory at San Francisco, 1908-11; director of the U. S. Leprosy Investigation Station in Hawaii, 1911-15; and director of the Hygienic Laboratory, 1915-37.

A leading authority on leprosy, Dr. McCoy was also widely recognized for his contributions in the fields of plague, tularemia, psittacosis, postvaccination complications, and biologics control. In collaboration with Dr. Charles W. Chapin, Dr. McCoy isolated, identified, and cultivated the causative organism of tularemia.

After his retirement from the Public Health Service in 1937, Dr. McCoy was professor of preventive medicine and public health and acting dean of the Louisiana State University School of Medicine until 1948.

Dr. McCoy received his doctor of medicine degree from the University of Pennsylvania Medical School and his doctor of science degree from Louisiana State University. Honors he received included the Sedgwick Memorial Medal of the American Public Health Association.

Measuring the Extent of Immunization

— in Grand Rapids and Kent County, Michigan —

By GRACE ELDERING, Sc.D., and PEARL L. KENDRICK, Sc.D.

In 1950, a study to determine the extent of immunization procedures and of prenatal and postnatal services was made in Grand Rapids, Mich., a city of less than 200,000 population, where unusual emphasis has been placed upon immunization procedures for many years. Questionnaires were mailed to mothers of all babies aged 12 and 13 months, with follow-up by telephone or nurse's visit when replies were not received by mail. This method of sampling, which was similar to that used in a study in Philadelphia in 1949, and described by Kandle and Goetz (1, 2), appeared to be reliable and useful, especially with regard to patterns of practice, and had the added advantage of being simple and inexpensive. We hope that, in addition to the actual information obtained, further experience with the method, this time in a smaller community, will aid in evaluating its general usefulness as a public health tool.

The area for study was extended to include not only the city of Grand Rapids but also the surrounding territory comprising Kent County,

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The City Health Department of Grand Rapids, the Kent County Health Department, and the Michigan Department of Health collaborated in this study.

in which about half the population is rural. The survey was conducted under the auspices of the city and county health departments. The pertussis field study group at the western Michigan section laboratory of the Michigan Department of Health, consisting of a nurse and a clerk, supervised by the laboratory section chief, and an additional nurse half-time for 4 months, formed the central working group for the study.

Selection of Sample

The total population of the study area was estimated at 286,235, with 176,235 in Grand Rapids and 110,000 in Kent County outside the city, subsequently referred to in this report as city and county, respectively. The sample for study included all the babies born during January, February, and March 1949.

Separate card files were prepared for city and county, and the names of the baby and mother, the address, race, and date of birth, obtained from the official birth records, were recorded for each baby born during the 3 months selected. The files were checked against the death records to remove from the sample the names of babies that had died. One hundred and ninety-two illegitimate babies were also excluded. The files used in the study contained 1,728 names, 1,071 for the city and 657 for the county, comprising 24 percent of the total births for the year. At the time the questionnaires were mailed, mid-February 1950, the infants studied were from 11 to 13 months old.

The questionnaire was essentially like the one used in the Philadelphia study (2).

Table 1. Number and percent of replies received before and after telephone follow-up and nurses' visits

Questionnaires	Total		Grand Rapids		Kent County	
	Number	Percent	Number	percent	Number	Percent
Mailed.....	1,728	100.0	1,071	100.0	657	100.0
Answered.....	1,547	89.5	964	90.0	583	88.7
By mail, no follow-up.....	1,026	59.3	634	59.2	392	59.6
After telephone call.....	340	19.7	181	16.9	159	24.2
By nurse's visit.....	181	10.5	149	13.9	32	4.9
Not answered.....	181	10.5	107	10.0	74	11.3

Preparation of the Community

Following the procedure used in the Philadelphia study, the importance of community-wide cooperation was stressed, not only to assure the success of the project, but also to broaden the area of its educational effect. The fact that in Grand Rapids there was a background of 25 years of cooperative work by the Michigan Department of Health Laboratory and the local health departments, including a series of field studies, facilitated the project. In the weeks just preceding mailing of the questionnaires every effort was made to acquaint the public with the survey objectives. The plan was outlined to the physicians through the Kent County Medical Society and the local Pediatrics Society. Through the health chairman of the Parent-Teachers Association, announcements were made to their local groups. In mid-February the two daily newspapers in the city and the weekly papers in the county carried news stories and a few weeks later followed up with feature stories. The local radio

stations made spot announcements during the week the questionnaires were sent out.

Returns

Three weeks after mailing the questionnaires, telephone follow-up was started. The two study nurses and the clerk reached as many as possible of the mothers from whom replies had not been received. In those instances in which the original form was reported lost or not received, a second questionnaire was sent. Three weeks later the nurses began home visits in the city. The two study nurses, with the help of the bureau of public health nurses, made the calls within the city. The county calls were left until last because of road conditions, and were made entirely by the two study nurses.

The number and percent of replies are summarized in table 1.

Of the 1,728 questionnaires sent by mail, 1,071 were to mothers living in the city of Grand Rapids and 657 were to residents of Kent County. The 1,026 replies received by mail

Table 2. Summary of replies to questions concerning immunization against pertussis

Immunization	Total area		Grand Rapids		Kent County	
	Number	Percent	Number	Percent	Number	Percent
Yes.....	1,228	¹ 79.4 ± 3.1	805	¹ 83.6 ± 3.6	423	¹ 72.5 ± 5.6
By own doctor.....	960	78.2	578	71.8	382	90.3
By health department clinic.....	245	19.9	209	26.0	36	8.5
Not stated.....	23	1.9	18	2.2	5	1.2
No.....	309	20.0	154	15.9	155	26.6
Not stated.....	10	.6	5	.5	5	.9

¹ Three times σ percent (assuming simple randomness).

without follow-up comprised 59.3 percent of the total, with the city and county returns in almost the same proportion. Telephone follow-up increased the replies to 79 percent, and nurses' visits brought in 10.5 percent more, making the final percentage 89.5. The proportions of replies received for Grand Rapids and for Kent County were essentially the same, 90 percent compared with 88.7. The relatively greater effectiveness of the telephone follow-up in the county is explained by the fact that greater effort was made to reach rural residents by telephone in order to save the time and expense of a nurse's visit. Replies were not obtained from 181 mothers (10.5 percent of the sample). The families could not be located, and it was presumed that they had moved or that the original address had been in error. The replies totaled 1,547, or 21 percent of the births during 1949, whereas in the Philadelphia survey, 61 percent of the questionnaires were returned by mail without follow-up and the total replies comprised 84 percent of the sample, which in turn represented 12.6 percent of the births for the year.

Analysis of Replies

The replies to the questionnaires were tabulated separately for the city of Grand Rapids and for the surrounding Kent County area. Within the city the four geographic divisions—northeast, northwest, southeast, and southwest—were analyzed separately, but the observed differences were so small that only the combined data are presented here.

The sample was composed entirely of white persons except for 45 Negroes in the city and 2

Indians, 1 in the city and 1 in the county. Thirty-five of the questionnaires concerning Negro infants were returned. While the sample was small, the replies suggested that in comparison with the white babies fewer of the Negro babies had been immunized, and that a larger percentage of the Negro babies had been taken to public clinics.

Pertussis Immunization

The replies to the question concerning pertussis immunization are summarized in table 2. The percentages are based upon the number of questionnaires that were answered.

The replies indicate that 83.6 percent of the Grand Rapids babies had received one or more immunizing injections against pertussis, while in the county the percentage was 72.5. Private physicians gave 71.8 percent of the inoculations in the city and 90.3 percent in the county. The results of the corollary question concerning the number of doses are summarized in table 3.

According to the table, 55.2 percent of the Grand Rapids babies and 48.5 percent of those in the county had at least two doses of pertussis vaccine. For the entire area the percentage was 52.7. Nine and eight-tenths percent were stated to have had one dose, and for 16.9 percent the number of doses was not stated.

Subsequent to the tabulation and analysis of the data from the questionnaires, further information was obtained concerning the pertussis immunization status of the babies in the Grand Rapids sample. Since the results of the second follow-up have significance with respect to both major objectives of the study, namely, actual information and evaluation of the method, the additional data are included here.

Table 3. Summary of replies related to number of doses of pertussis vaccine

Was the baby immunized?	How many doses?	Total area		Grand Rapids		Kent County	
		Number	Percent	Number	Percent	Number	Percent
Yes	1	152	9.8	107	11.1	45	7.7
	2 or more	815	52.7	532	55.2	283	48.5
	Not stated	261	16.9	166	17.1	95	16.3
No		309	20.0	154	15.9	155	26.6
Not stated		10	.6	5	.5	5	.9

We were concerned first by the large number of replies in which the number of doses was not stated, although the main question, "Has the baby been immunized . . .?" was answered affirmatively. Of the 166 who gave such replies in Grand Rapids, we were able to investigate 124 further: 38 were found in the city health department immunization clinic files and 86 who had been immunized by private physicians were checked by telephone call to mother or doctor. All of these 124 babies had a record of two or more injections of combined diphtheria toxoid and pertussis vaccine at the time of the survey.

We were also interested in the babies stated to have had one dose of pertussis vaccine. According to the questionnaires, many of these had received smallpox vaccination, usually not given until diphtheria and pertussis injections are completed. Of the 107 Grand Rapids babies in this category (table 3), 79 were located again. Twenty-one were found in the city immunization file and of these, 13 had completed the series at the time of the survey. Of those immunized by their own doctor, 58 were found again. Seventeen had had only one injection, 2 had received two injections, and 39, the full course of inoculations at the time of the survey. Referring now to table 3, if we add to the 532 with "two or more" doses of vaccine the 124 from the "not stated" group and the 54 from the "one dose" group we have 710 with at least two doses, or 74 percent of the Grand Rapids sample. This is obviously still less than the true figure since 72 of the "not stated" and "one dose" groups were not followed up the second time. Why so many mothers either left unanswered the question on

number of doses, or gave the incorrect answer of "one dose" when the child had actually had the complete course we do not know. A different wording of the questionnaire, such as "How many injections?" might have been more successful.

Diphtheria Immunization

The replies to the second question, which concerned diphtheria immunization, are summarized in table 4.

Since combined diphtheria toxoid and pertussis vaccine had been in general use in this area for several years, similar replies would be expected to the first two questions, and the differences observed in the figures in tables 2 and 4 are small. For the whole area, 75.8 percent of the babies were stated to have received diphtheria immunization. The Philadelphia survey indicated that in that city 63 percent of the white babies and 41 percent of the Negro babies had two or more immunizing injections against diphtheria.

Smallpox Vaccination

The replies to the question on smallpox vaccination indicated a relatively low level of immunization at the age sampled—27 percent in the county and 40 percent in Grand Rapids, or 35 percent in the entire area. This is explained by the fact that the recommended procedure here advises smallpox vaccination at 1 year of age.

Prenatal Care

The replies to the questions regarding prenatal care indicated almost identical patterns in the city and the more rural area within the

Table 4. Summary of replies to questions concerning diphtheria immunization

Immunization	Total area		Grand Rapids		Kent County	
	Number	Percent	Number	Percent	Number	Percent
Yes.....	1, 172	¹ 75.8±3.7	769	¹ 79.7±4.4	403	¹ 69.1±7.0
By own doctor.....	939	80.1	572	74.4	367	91.0
By health department.....	222	19.0	190	24.7	32	8.0
Not stated.....	11	.9	7	.9	4	1.0
No.....	350	22.6	179	18.6	171	29.3
Not stated.....	25	1.6	16	1.7	9	1.6

¹ Three times σ percent.

Table 5. Analysis of replies to question concerning pertussis immunization from the Grand Rapids area, according to those obtained by mail, telephone call, and nurse's visit

Replies	Total	Yes		No		Not stated	
		Number	Percent	Number	Percent	Number	Percent
Total.....	964	805	83.5 ± 3.6	154	16.0	5	0.5
By mail.....	634	570	89.9	62	9.8	2	.3
By telephone.....	181	131	72.4	47	26.0	3	1.7
By nurse's visit.....	149	104	69.8	45	30.2	0	.0

¹ Three times σ percent.

county. In answer to the query, "Who took care of you during your pregnancy?" 98 percent of the mothers stated "private physician," 1 percent (18 mothers) stated "hospital clinic," and 1 percent left the question unanswered. As to the time of first visit to doctor or clinic, 78 percent went during the first trimester, 18 percent during the second, 2 percent in the last trimester, and 2 percent did not state time of visit. With regard to nursing care, 15 percent of the Kent County mothers and 18 percent of the Grand Rapids mothers stated they had been visited by a public health nurse during their pregnancy. About one-fourth of those receiving visits had only one, while 50 percent had received from two to four visits.

Postnatal Care

The replies to the questions regarding postnatal care revealed several differences between the two areas under study. Eighty percent of the Grand Rapids mothers said they had been visited by a nurse after the birth of their baby, compared with 47 percent of the Kent County mothers. In this connection it should be explained that the community health nurses make visits only within the metropolitan area of Grand Rapids.

At least 85 percent of those receiving nurse's visits stated that the nurse called during the first month after the baby's birth; 34 percent recorded only one visit, and 55 percent stated there had been from two to four.

Eight percent of the mothers in both areas stated that their babies had received no medical check-up. An additional 4 percent left this question unanswered. Among those who had medical attention, the number of check-ups

varied, with more for city than county babies. Approximately 50 percent had from one to four, while roughly one-fourth had from five to nine. Medical check-ups for 84 percent of the Grand Rapids babies were made by private physicians, 1 percent by a hospital, and 13 percent by the baby clinic. In the county, 92 percent were made by a private doctor, 2 percent by a hospital, and 4 percent by the baby clinic.

Comments by Mothers

A postscript to the questionnaire, asking for suggestions for the improvement of child-care services, brought responses from 124 mothers, half in the city and half in the county. About one-third of the statements expressed only gratitude and commendation. There were 23 definite complaints, most of them because of "lack of nursing service." Twenty mothers requested help on specific problems, such as need for transportation to an immunization clinic or advice concerning a sick baby. Of 20 constructive suggestions from city mothers and 29 from mothers in the county, 16 asked for more nursing service, 13 cited the need for making known the available services, and 20 requested more immunization clinics and well-baby clinics.

Comparative Value of Follow-Up

The question arises as to the value of the follow-up by telephone and nurse's visit to obtain replies not returned directly by mail. For information as to whether it was worth the additional time, effort, and money required to gather the telephone and visit data, the replies to the question on pertussis immunization for

the Grand Rapids sample were analyzed with respect to the method by which they were obtained. Table 5 shows the breakdown of the 964 replies to the questionnaires sent to 1,071 mothers.

The percentages of affirmative replies by mail, telephone, and nurse's visit were 89.9, 72.4, and 69.8, respectively, indicating a statistically significant difference. These results suggest that the data concerning the 107 babies for whom questionnaires were not returned would also have been different from the data returned directly by mail and emphasize the limitations of the survey method.

Summary and Conclusions

1. A survey of the immunization status of 1-year-old infants and of certain nursing services to mothers and babies was conducted in Grand Rapids and Kent County, Mich. The sample was selected and data obtained according to the method of Kandle and Goetz, using a mailed questionnaire with follow-up by telephone calls and nurses' visits.

2. Replies were received from 89.5 percent of the mothers to whom questionnaires were sent. The sample of 1,547 replies represented 21.5 percent of the births during 1949.

3. According to the replies, two or more injections of pertussis vaccine had been given to 52.7 percent of the infants. As a validation procedure, this information was amplified and corrected by checking with the city health department immunization files and by additional follow-up by telephone. The corrected figure for the city was about 74 percent. The survey method was considered inadequate for obtaining such detailed information as number of injections.

4. In Grand Rapids, 71.8 percent of the babies who had been immunized received their pertussis immunization from private physicians and 26 percent from the health department clinic; in the county these percentages were 90.3 and 8.5, respectively.

5. Prenatal care was given almost entirely by private physician rather than hospital clinic or health department. Fifteen percent of the mothers in the county and 18 percent in the city had been visited by a public health nurse during their pregnancy.

6. The pattern of postnatal care varied somewhat in the two areas; more nursing calls were made in the city than in the county, and a higher percentage of the city babies were taken to baby clinics for medical check-ups.

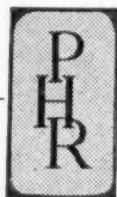
7. The comments by the mothers showed a surprising lack of knowledge of the health services available in the community. As the study progressed there was obviously an increased interest which, although not subject to measurement, indicated that the survey had educational value.

ACKNOWLEDGMENT

Acknowledgment is made to Dr. Robert Rothermel for his assistance in the setting up of the study; to Dr. Roscoe Kandle for making available unpublished tabulations of the Philadelphia study; and to the press, the radio, and the Parent-Teachers Association of the city of Grand Rapids for their help with publicity.

REFERENCES

- (1) Kandle, Roscoe P., and Goetz, Henry: A practical method of securing data regarding services to mothers and infants. *Am. J. Pub. Health* 39: 1451-1454 (1949).
- (2) Kandle, Roscoe P., and Goetz, Henry: A method to determine levels of immunization, medical, and nursing services in prenatal and infant care. *Pub. Health Rep.* 65: 315-330 (1950).



Home Accident Prevention Activities

By FREDERICK S. KENT, M.P.H., and MADELINE PERSHING, M.A.

Much has been written and many discussions have been held on the problem of home accidents, their prevention, and their relationship to public health. The continuing high accidental injury and death rates represent to conscientious health workers a negation of many of the positive advances that have been made in the prevention of disease during the past several decades. Because of the growing awareness among health workers of the urgency of the problem, it seems appropriate to review past endeavors in home accident prevention, to reconsider present problems in the light of history, and to contemplate the future.

The Accident Problem

Mortality

Accidents, as a cause of death, were relatively less important in the early part of this century when communicable diseases were on the rampage. However, as the combined efforts of the public health and medical professions slowly, and in some instances dramatically, tamed these major killers, accidents rose in relative rank until now they stand among the leaders.

For many years the only figures available on accidents were those derived from analysis of death certificates. In view of the need for more specific reporting, a standard accident reporting system was developed in 1925 by the National Safety Council, as an approach to

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national uniformity in reporting of fatal accidents (1). The Census Bureau began publishing data on deaths from home accidents in 1935. None of these activities included the gathering of statistics on nonfatal accident.

With better reporting of figures on fatal home accidents, and realization of the magnitude of the problem by public health agencies, the next step was the standard epidemiological approach—what, how, why, where, and when—to form the basis for planning a practical home accident prevention program.

To define the accident problem more clearly, the National Office of Vital Statistics, Public Health Service, developed a general accident-fatality form in 1949 which included a part of the standard death certificate plus epidemiological information desired on all non-motor-vehicle accidents. Since motor vehicle accidents already were being investigated and reported, this additional type of information appeared necessary to focus the total accident problem more clearly. The form was offered to the States as an aid in studying their own accident problem, and 18 States used it during the 1½ years in which it was available. In 1950, the National Office of Vital Statistics, wishing to ally their efforts more closely to other special efforts then being made by the Division of Sanitation of the Public Health Service, replaced the general accident-fatality form with the more specific home accident fatality form now used in 10 States.

Morbidity

Although all of these studies and evaluations stressed the importance of accidents in public health work, it was appreciated that they by no means presented the total problem.

There was a need to supplement such information with more facts and figures on the extent and circumstances of nonfatal home accidents.

Probably the first study to obtain data on nonfatal accidents was the National Health Survey of 1935-36 (2). The survey's findings indicated the magnitude and public health importance of home accidents and suggested the need for more intensive studies of specific causes of accidents, particularly from the point of view of developing methods of prevention. (The oft-used ratio of 150 nonfatal home accidents to each fatal one was based on the data gathered in this survey.) The survey produced enlightening information not previously available, but the sample selected represented only 3.6 percent of the 1930 urban population of the United States. The information elicited on accidental injury concerned an even smaller percentage. Also, the survey did not include rural homes, thus omitting consideration of many conditions having an accident potential not ordinarily found in urban dwellings.

Since the collection of statistics is not an end in itself, the facts gathered from both morbidity and mortality studies are the stepping stones which categorical activities of the health department should use to plan and evaluate home accident prevention programs.

At the Local Level

The National Safety Council, the Subcommittee on Accident Prevention of the American Public Health Association, the American Red Cross, and the Public Health Service have all recognized that the prevention of home accidents is essentially a local problem.

State health departments in conducting studies of home accidents have found that the chief types, in relative importance, follow a common pattern. However, although falls, burns, and poisoning strike in similar ratios in most areas, the causative factors may vary significantly in different localities. Such differences require variation in methods of control for specific application to specific problems.

Experience has illustrated the advisability and practicability of using the "rifle" approach of hitting the major problems, rather than the "shot-gun" approach of scattering our efforts

in the hope that some of them may be productive. The home accident prevention program must be directed to those causes or to those age groups constituting the bulk of the home accident problem. Funds, personnel, and time are too scarce to be wasted on less significant aspects of the problem.

The statistical basis for such a "rifle" approach was first utilized by Dr. Earl G. Brown while he was commissioner of health for Kansas. He initiated the collection, tabulation, and analysis of statistics relating to fatal accidents, on a continuing basis, at the State level, thereby demonstrating the practical value of this philosophy.

It is important that as essential as statistics and epidemiological investigations of fatal accidents are, they still must be supplemented with detailed information on the types and causes of the greater number of home accidents resulting in injury but not in death. This supplemental information has been, and is being, obtained in several ways. By no means do we have the perfect method yet, but each procedure, despite limitations, adds to our store of knowledge.

Among such supplemental sources of information are the hospitals in a community. Red Cross chapters in large cities like Washington, D. C., Atlanta, Ga., and Kansas City, Mo., have learned that hospitals will cooperate in conducting studies of nonfatal home accidents. Reports prepared by the hospital staff, using data collected from the out-patient and in-patient services and emergency rooms, are made available to control agencies. They represent one contribution which hospitals can make as members of the community team. While these statistics do not represent a cross section of the accident problem, they are indicative of areas in which activity is needed. It is well worth the health department's effort to obtain the cooperation of the planning and operating levels of a hospital in supplying such data.

Case Evaluation

It is obvious that analysis of records on fatalities and injuries will not present the whole problem. The goal should be the investigation of every accident, whether or not it results in injury. But although the desirability of studying each accident experience, regardless of its

end, cannot be questioned, we must realize the impracticability of this procedure.

Of four individuals who may experience the same accident, for example tripping on a torn stair carpet, one may fall and be killed; another may fall and fracture a leg or arm; the third person may not fall, but in twisting, may sprain an ankle; while the fourth may catch himself and go on his way without injury of any kind. Undoubtedly, the circumstances in the first case will be remembered by witnesses, in the second case by the individual himself for a long period of time; in the third case for a week or so; and in the last case no longer than a few minutes or hours.

Therefore, we must set a criterion, or definition, for "reportable" experiences that will be remembered and recounted on interview to give us a basis for comparing the findings of studies and for evaluating the effectiveness of programs. The National Safety Council and the Public Health Service recommended the criterion now used in demonstration projects and other programs in which nonfatal accidents are being studied: "A reportable home accident is one which causes an interruption of normal activity for a period of at least 24 hours beyond the time of injury." There are, of course, exceptions to the rule, but these are few in number and tend to strike a balance.

Community Demonstrations

In 1948, the W. K. Kellogg Foundation became interested in the home accident problem. Following discussions with the Public Health Service, the Foundation's division of public health recommended that its board of trustees appropriate funds for a demonstration program in home accident prevention by a local health department. Dr. Winston B. Prothro, health officer, Kalamazoo (Mich.) City-County Health Department expressed interest and submitted an application for a grant outlining a comprehensive program for investigating the home accident prevention problem and developing preventive measures. In September 1948, a grant was made to the Kalamazoo Health Department "to demonstrate the possibility of effecting a significant reduction of mortality and morbidity caused by home accidents" (3).

The demonstration program at Kalamazoo is

now in its fourth year. The results of the early period of this demonstration led to the Public Health Service recommendation that additional demonstrations be undertaken in different areas of the United States in health departments of varying size and composition. The Kellogg Foundation favored the proposal, and after reviewing applications from 41 local health departments, selected three to undertake demonstration programs for periods of 3 to 5 years. In August 1951, demonstrations were started by health departments in Cambridge, Mass., San Jose, Calif., and Mansfield-Richland County, Ohio.

Each of these four programs is developing its demonstration based on its individual philosophy and approach, and in accordance with its operational pattern and legislative responsibility. In each case, however, four basic objectives have been accepted as guiding principles: first, to determine inexpensive and practical methods for reporting nonfatal home accidents; second, to determine the methods and continuing need of in-service education for health department personnel; third, to include home accident prevention techniques and education in all regular health department activities, as an integral part of all functions and operations; and fourth, to evaluate all such activities in the light of their effectiveness, and then determine the relative place of home accident prevention activities in a local health department and the responsibility the health department should accept for home accident prevention. In these demonstrations, the recommended criterion for reportable home accidents is being used in the compilation of statistics on nonfatal home accidents to permit comparison of magnitude and detail of the accident problem as well as evaluation of program effectiveness among the four projects. This in no way precludes epidemiological investigation of any or all home accidents in these project areas.

Thus, four different methods of establishing a base line and compiling data on nonfatal home accidents are being tried. In Kalamazoo, a survey of the entire population, city and county, is conducted annually in conjunction with the school census wherein all homes are visited by enumerators. Home accident cases thus located are checked at a later date by health depart-

ment personnel and the circumstances of each accident are investigated.

In Cambridge, a sample survey is being conducted, in which 1,000 families are visited by health department nurses and sanitation personnel to determine the frequency of, and the various factors involved in, home accidents.

In San Jose, questions regarding home injuries are being incorporated into a morbidity research project conducted under the sponsorship of the California State Health Department. This study of a representative sample of the population will determine the amount of illness in San Jose during a specific period of time. The demonstration program is fortunate in being able to acquire its base line as a byproduct of such a research project.

In Mansfield, Ohio, a survey is planned which will include approximately 25 percent of the families residing in the Mansfield-Richland County area. The interviewing will be conducted by YWCA volunteers trained in interview techniques. The Ohio State Health Department will tabulate the final results.

There are still other methods of collecting data on nonfatal home accidents. A home accident survey made by the public health nurses in Lynn, Mass., was reported by Dr. Helen Roberts of Harvard University. The survey, conducted during 1949-50, was made a part of the nurses' regular duties, so that in the course of home visits, the families were routinely queried as to occurrence of home accidents. Though this study was small, the findings did indicate the kind of information determinable from this type of survey.

Scientifically designed sample surveys will provide representative results of the problems in an area within acceptable reliability. However, such surveys are expensive and ordinarily not undertaken without outside assistance, financial or otherwise, as in the case of the San Jose morbidity research project. However, all health departments can analyze home accident fatality report forms and supplement these findings with inexpensive studies of nonfatal home accidents and with hospital reporting to determine some of the major factors at which preventive measures must be aimed, even though incomplete and not a cross section of the community problem.

Research

The inauguration of demonstration projects and activities in the health departments drew attention to the need for extensive home accident research on problems of major importance to all future activities.

In 1950, the University of Michigan School of Public Health, recognizing the growing interest in home accident problems, the consistently high mortality, the impressive number of accidents attributed to environmental causes, and the insufficient studies of these elements, requested a research grant from the Public Health Service to study the incidence of home accidents, hazards existing in the home, and the accidents themselves. The project was begun in February 1951.

The findings from the study will be related to health department practices, including suggestions for accident investigation, family education in safety practices, and methods of eliminating structural and operational hazards associated with home accidents. An effort will be made to suggest a method for local health departments to design and conduct inexpensive surveys on small random samples that will provide statistically significant figures on incidence.

As studies of types and causes of home accidents and of age distribution were evaluated, it became apparent that further study was needed on specific problems related to accidents among children. The work of Dr. Flanders Dunbar provided initial guidance in reviewing certain aspects. Supplementary knowledge based on studies of injury-prone children was provided by Dr. Elizabeth Fuller of the University of Minnesota Institute of Child Welfare.

The Metropolitan Life Insurance Company made a grant to Dr. Rustin McIntosh to conduct at the Babies Hospital of the Columbia-Presbyterian Medical Center in New York a study of accident proneness in children. The study, now under way, will include a thorough analysis of the history and current status of a number of child accident repeaters and their families, in comparison with a control group relatively free of the accident habit.

Mechanical suffocation of infants is another indication of the need for special studies.

More than 50 percent of the accidental deaths occurring in infants under 1 year have been attributed to mechanical suffocation. Dr. Jacob Werne and Dr. Irene Garrow of New York City studied every infant death from mechanical suffocation reported over a 15-year period in Queens County, N. Y. Their findings indicated that in no instance was mechanical suffocation proved to be the cause of death in a healthy infant, whether by bedclothes or in an analogous manner, but resulted chiefly from pulmonary infections (4).

Dr. Katherine Bain of the Children's Bureau, Federal Security Agency, convened a group of pediatricians, pathologists, and others interested in the problem to discuss steps to be taken to resolve this controversial issue. The group recommended that research studies be undertaken by outstanding pathologists in several large cities to determine actual causes of sudden deaths in infants. Under a Public Health Service grant, Dr. Sidney Farber of Harvard University Medical School, as principal investigator, and Drs. Richard Ford, Jacob Werne, Alan Moritz, and Russell Fisher are working on a research project to "study in a systematic and coordinated fashion a sufficient number of cases of infants dying unexpectedly while in apparent good health, in order to determine the nature of this syndrome and its etiology. Four large cities will be selected initially. In each, all infants between 1 week and 1 year of age dying unexpectedly while apparently in good health will be studied. Each case will have complete pathological studies, including histological and bacteriological, viral studies, and environmental studies. Data will be collected in a similar manner in all centers and will be pooled and evaluated by a central committee."

Recently the American Academy of Pediatrics requested the American Standards Association to set up, under their procedures, a project for the development of standards for equipment, clothing, and other materials which may present accident hazards to children—flammability of textiles, toxicity of paints and household chemicals among others. Plans have been formulated for such an undertaking.

National Programs

Although our present consideration is limited to public health agencies, the contributions of the National Safety Council, Metropolitan Life Insurance Company, and other vitally interested organizations in the field of home accident prevention are numerous and meritorious.

The Subcommittee on Accident Prevention was appointed by the American Public Health Association in 1942. In 1944, the scope of the subcommittee was narrowed to consideration of home accident prevention activities, and in the same year, the subcommittee prepared a paper on recommended activities for each professional discipline in a health department. Since then it has sponsored special home accident prevention sessions at the annual APHA meetings.

Its most recent endeavor was the investigation of the type and amount of home safety education included in the curriculums of schools of public health and public health nursing. The data so far collected indicate an interest in further development of home accident prevention philosophies and methods as an integral part of the over-all curriculum. The information gathered indicates also a wide variety of methods and frequency with which the problem of home accidents is included in a formal educational program. In no instance did a school cover the subject as completely as believed necessary to give the health worker adequate knowledge with which to meet the problem in his own work situation. Recently a task force of the subcommittee has been preparing material to use as curricular guides for schools of public health nursing.

The home accident prevention program of the Public Health Service was inaugurated in 1947 with the assignment of full-time personnel to this activity. Much ground work had been done before then by Public Health Service personnel who had studied the problem while assigned to other activities. Early in the inception of the home accident prevention program, an advisory committee composed of representatives of various Public Health Service functions adaptable to home safety work was appointed

by the chief of the Bureau of State Services to guide development of the objectives, philosophies, responsibilities, and operational activities of the home accident prevention unit in the Division of Sanitation.

The Public Health Service has stimulated interest and activity in home accident prevention among State and local health departments through consultation, public health meetings, guidance in research and demonstration projects, preparation of special survey and training materials, and distribution of packets and brochures. Public Health Service personnel in the Federal Security Agency regional offices, aware of the attitudes toward, and programs of, home accident prevention in the States within their regions, have been active in offering more specific contributions toward planning home accident prevention activities in health departments within their areas.

State and Local Activities and Needs

The home accident problem, although of national scope and importance, will be controlled in essence by the efforts expended at the local level. National or Federal organizations and agencies can correlate and disseminate the results of various undertakings and can suggest the broad but general framework for preventive programs. The State health agencies can make these suggestions more specific for their localities, but the pinpointing of effort must be done in and by the community.

According to current information on home accident prevention activities in health agencies throughout the Nation, 15 State and 13 local health departments have activities in progress. The activities range from the well-rounded program of demonstration projects to modest efforts limited to one professional group within the health department or to one specific activity.

Careful review and analysis of the reports of studies already described have provided information to formulate basic principles of accident prevention. These facts, plus the attitudes of individuals and health groups, and the programs already reported upon or in progress, have given the premise upon which the

philosophy of the Public Health Service in home accident prevention has been built. That philosophy includes the following precepts:

First, home accident prevention is a matter primarily for individuals, families, and community groups. The problem must be met chiefly by the person or group having direct contact with the potential accident victim or his home.

Second, home accident prevention, to be effective, must be a continuous program, aimed at elimination of hazards in the environment and correction of accident-potential characteristics within the individual.

Third, research and investigation into conditions and situations now known to have, or suspected of having, an accident potential should be continued.

Fourth, all home builders, manufacturers, and members of medical, educational, and allied professions should be encouraged to contribute their skills and knowledge to this problem.

The Public Health Service believes that professional public health workers, physicians, and the auxiliary professions must provide leadership and stimulation toward solution of the home accident problem.

Home accident prevention has come out of the laboratory and is now in the development stage. We may look to its integration in all health departments, into every program which seeks to protect the family and the individual in their home environment. In the meantime, there is ample room in the field now for health workers wanting to pioneer in a new territory and to contribute to a new concept of public health.

REFERENCES

- (1) Accident facts. Chicago, National Safety Council, 1928.
- (2) Britten, Rollo H., Klebba, Joan, and Hailman, David E.: Accidents in the urban home as recorded in the National Health Survey. *Pub. Health Rep.* 55: 2061-2087 (1940).
- (3) Prothro, W. B.: Home accident prevention. *Am. J. Pub. Health* 41: 954-958 (1951).
- (4) Werne, Jacob, and Garrow, Irene: Sudden deaths of infants allegedly due to mechanical suffocation. *Am. J. Pub. Health* 37: 675-687 (1947).

Epidemiological Techniques in Home Accident Prevention

By HELEN L. ROBERTS, M.D., M.P.H., JOHN E. GORDON, Ph.D., M.D.,
and AUTINO FIORE, M.D., M.P.H.

To consider the application of epidemiological techniques to home accidents is to recognize the altered character of preventive medicine. Twenty years ago, even if sufficient information had been available on which to base control programs, not enough interest could have been aroused in the preventive aspects of cancer, diabetes, rheumatoid arthritis, and mental disorder to make possible active public health programs. The broadened concept of preventive medicine has come now to include not only these chronic diseases, but also injuries of accidental origin (1). Today's concept also presupposes the inclusion of control activities against traumatic injuries as a practical and reasonable part of medical and public health practice.

The Problem of Accidents

Various indices determine the relative emphasis to be placed on leading threats to health. Deaths, disability, defects, and the availability of effective preventive measures are the usual determinants. If deaths alone are considered,

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This paper was presented before the Subcommittee on Accident Prevention, American Public Health Association, October 31, 1951.

accidents merit serious attention, for, although the total death rate from accidents in the United States decreased from 85.5 per 100,000 population in 1918 to 59.5 in 1950, the relative importance of accidents as a cause of death has increased. In 1950, deaths from accidents ranked fourth in the United States, as compared with sixth position in 1935 (2).

Accidents are classified into four principal groupings according to the place of occurrence—those that happen in homes, at work, in public places, and in association with motor vehicles. Our concern here is with home accidents because they are being accepted as within the particular province of public health and preventive medicine, and because, numerically, accidents in the home make up a very large class.

Cause and Prevention

Home accidents caused over 30.5 percent of all accidental deaths in the United States in 1950. It is estimated that approximately one-half of nonfatal accidental injuries were due to home accidents—4,100,000 of a total of 9,000,000—and that 110,000 persons were left with a permanent physical defect as a result of a home accident. Thus, for every accidental death in the home, 145 persons were temporarily disabled, more than for any other class of accident, and 4 suffered a permanent impairment that varied from a minor handicap to complete crippling. Home accidents alone are ranked ninth among the leading causes of

death, according to the National Safety Council (3).

Demographic data such as are mentioned above establish the significance of home accidents as a cause of death, disability, and defect. However, preventive measures and their effectiveness must be evaluated if a case is to be made for the inclusion of home accident control in public health and medical practice. Industry has demonstrated that exact knowledge of industrial accidents will show the way to effective control. All industries reporting to the National Safety Council in 1947-48 revealed a 13-percent decrease in frequency of accidents and a 9-percent decrease in severity of accidents since the base period of 1935-39 (3). Trends in occurrence of certain types of motor vehicle accidents have shown a marked improvement as the result of selective control measures made possible by intensive study of the circumstances of accidents. In Massachusetts, for example, holiday automobile accidents happened twice as often during the evening hours as during the morning hours, even though the same number of drivers were on the road at these two peak periods. Also, specific streets and intersections had higher than average rates. On the basis of this information, police officers were stationed at prescribed places at definite times—with a resultant favorable accident record never before attained on holidays (1).

These control examples in other classes of accidents emphasize that similar epidemiological knowledge of home accidents is yet to be gained. Just as a few centuries ago ignorance of cause led medical practitioners to ascribe disease to demons, so today we blame bad luck or chance for accidents. Accidents have specific causes, just as have the communicable diseases. Public health has long since abandoned blanket control measures as nonproductive and expensive. What is needed is sufficient knowledge of the three interlocking elements in causation—the host, the agent, and the environment—to permit the application of specific, pinpointed preventive measures.

There is no single cause of accidents in general, nor of any one type of accident (1). An approach to the predominant element of cause is made most readily by the method proved useful in the control of communicable diseases and

which is now being applied to chronic diseases—the epidemiological method. As applied to home accidents, the epidemiological approach is simply the collection and analysis of all the facts about accidents in a given community—when and where home accidents occur, how they occur, and to whom the accidents happen (4).

Methodology of Mass Study

To date, our epidemiological approach to cause in home accidents has suffered from several mistakes in methodology which have made sincere efforts of limited value. First, too great emphasis has been placed on analysis of deaths from accidents. Important as this analysis is, it ignores the critical information to be obtained from the study of nonfatal accidents. If the epidemiological study of diphtheria had depended solely on autopsy findings and the circumstances of deaths from diphtheria, our present knowledge would be sadly deficient. Accidents, too, show a gradient of disease or injury as a result of a prescribed exciting cause—a similar occurrence may lead to loss of life in one individual and, in another, to no more than a loss of equanimity. Only a concerted study of all accidents—those resulting in minor injuries as well as those with major sequelae—will permit a real knowledge of cause.

Second, too many facts about accidents have been gathered haphazardly without well-defined epidemiological objectives, and have been put together with no regard for the varying predominance among causative factors, of the behavior and characteristics of the person suffering the accident, the site of the accident, and the immediate agent giving rise to the event.

Third, in formulating local control programs, too great dependence has been placed on national statistics. Home accidents vary from community to community, depending upon occupation, age of population, housing, economic resources, geographic area, and many other factors. General principles in analysis and prevention may be similar in different areas, but only concentration upon its own home accident occurrence will enable an area, a city, or a State to define its individual situation and thus apply specific control measures.

The task, therefore, is to evolve practical methods that can be used by an individual community to determine the causes of its home accidents. Upon a firm basis of epidemiological knowledge of the disease, control can be built.

There are, of course, a number of ways of going about the epidemiological investigation of home accidents, especially those that are not fatal. There are, also, practical limitations of time, personnel, and funds which face the health department and other community groups which wish to move forward in this important sector.

Experience suggests that when substantial funds are not available, the studies that can be undertaken are limited to such things as collection and analyses of mortality statistics, hospital records, and reports obtained by nurses and sanitarians in the course of their routine visits to the homes in the community. Certainly these inexpensive studies are not complete, nor a cross section of a community problem, but they are indicative of some of the major factors at which preventive measures must be aimed. Any sample survey large enough to be statistically significant within the variance desired becomes an expensive item and, in most cases, can be undertaken only by a few health agencies fortunate enough to obtain supplementary funds for such a project.

Several of the more promising epidemiological approaches to home accidents are described in the following paragraphs. We have had experience in the use of several of these techniques in the community, and others are now being tested.

Mortality Analysis

Although we have criticized the restriction of epidemiological studies of home accidents to mortality data, we do not deny their importance. As a matter of fact, this is a logical point of departure for the community wishing to know the facts concerning accidents occurring locally.

A statistical analysis of accidental deaths during the past 10 years, compiled from death certificates, forms an essential base line for future evaluation of control programs as well as giving some indication of serious hazards in

the area. A continuing record of home accident deaths as they occur in the community should be maintained by the health department. Information contained on death certificates is insufficient for this purpose. The State of Kansas and Nassau County (New York) have demonstrated that information about all the circumstances of a fatal home accident, collected from families, physicians, and others concerned with a case, adds immeasurably to epidemiological evaluation.

The "Home Accident Fatality Report," prepared by the National Office of Vital Statistics, Public Health Service, is an important means of developing systematic information on home accident deaths.

Definitions and Terminology

The design of a study of nonfatal injuries in a community involves serious consideration of and decision on several perplexing definitions. For example, what is an accident? A dictionary definition is insufficient. Shall intention rule out a case? Most of us consciously take actions fraught with calculated or undefined but appreciated risk. How shall we dispose of the unsafe act resulting in no injury? Shall resultant injury determine the occurrence of an accident? And, if so, how shall "injury" be defined?

The National Safety Council's definition of an accident excludes any event which results in disability of less than 1 day. Use of this definition has led to uncertainty in many cases. For instance, age greatly influences disability resulting from accidents. A prescribed event may disable an elderly lady for a week or more, but at most may only inconvenience a young child. Furthermore, occupation may determine the degree of disability. An executive who fractures a metacarpal may not miss a day's work. He is able to dictate his letters as usual, but such an injury is incapacitating to a typist in his office.

Other terms requiring definition are: the home; the usual place of residence; the determination of duration of risk in the home; the inclusion of visitors in the list of persons exposed to risk; and indices of economic status and reliability of informants.

Each of these terms needs to be defined prior to an individual study, even though no universal definitions are sought. The important consideration, if confusion is to be avoided, is clarity in definition of terms and agreement among all workers on the type of information to be included before actual collection of facts is undertaken.

Studies of Nonfatal Accidents

The kind of study selected by the community to determine the epidemiological facts of nonfatal accidents will depend on the method of finding cases, and upon the finances and personnel available. The survey may include only one or a combination of case-finding methods.

Hospital Admissions

Community hospitals in many areas are most cooperative in aiding health departments in home accident studies. A continuing study of admissions to out-patient treatment and to in-patient wards may profitably be utilized to assess the circumstances of more serious home accidents. Hospital records alone usually do not supply the needed epidemiological data, but can be enlarged by an accident history obtained from the patient or from a member of his family, by study of the site of the accident, and by cooperation of the attending physician.

The number of accidents and the relative gravity of the injuries suffered by patients admitted to hospitals will vary from one community to another, depending on availability of hospital facilities, economic status of the population, and customs of the community in seeking hospital treatment. However, a sample drawn from hospital admissions is always highly selective and is not representative of all home accidents occurring in the community. To study hospital admissions alone, as to study deaths alone, is to underrate greatly the medical, economic, and social seriousness of the problem (4).

Health Department Routine Activities

A reasonable compromise in epidemiological technique for the health department with limited funds and personnel is to include a home accident survey in the activities of health de-

partment employees making routine visits to homes. If other surveys, such as housing, are being conducted by the health department, home accident investigations may easily be added, and may be carried on by the personnel doing the primary survey.

Even better, however, is to have the nurses of the health department and visiting nurse association include—as part of their regular home visit procedure—questions about accidents occurring in the home during the past month. Although a sample drawn from clients of public health nurses rarely will be representative of the total population of the community, this disadvantage is balanced to some extent by extensive knowledge of accidents that occur in that portion of the population in which the health department subsequently may be conducting an accident control program (5).

In certain areas in Massachusetts, nonprofessional personnel have been used for studies of this type. We have not accumulated sufficient experience to show the relative value of data so collected and data obtained by professional workers.

A convenient form for recording epidemiological data is used. The household roster is used to calculate the number of persons at risk. All survey workers must be fully informed about the accident problem, the objectives of the study, the definition of terms, and the use of the record form. Each investigator should be provided with a code to the record form.

Extensive Study of Home Accidents

The objective in an extensive study of home accidents is to determine the distribution of accidents in a representative sample of the population, and the controllable causative factors in accident events. Professional investigators are utilized in such a study. Since only one visit is made to designated households, only information on major home accidents is sought. A practical criterion of gravity of injury is whether or not the person was under medical care.

The purpose of this type of study is to provide basic facts about the home, the family, and major home accidents during the preceding

year. Additionally, the information obtained is perhaps the best guide in selecting a sample for the intensive type of study next described.

Granted an adequate sample, the accident prevention program may be planned on information collected in the first year of the study. Continued observations over a 3- to 5-year period would add to knowledge of causation, and, most importantly, serve to evaluate the accomplishments of control measures. However, this approach—as in the case of the intensive investigation described below—requires a substantial investment in time and funds for study design, field work, and analysis and interpretation.

Intensive Study of Causation

Essentially nothing is known to account for the frequency of home accidents in a given population. No adequate data are available concerning the characteristics of the population at risk, the actions and characteristics of the victims of accidents, and technical analysis of the environment in which accidents did and did not occur.

A study designed to obtain data and to assess these features in accident causation would include periodic visits to selected families. Ideally, the group would be made up of a random sample, but a more practical aim is a smaller sample, obtained by stratification or other means to assure that it will be closely representative of the community. The size of the sample is determined by numbers of available investigators—possibly including public health nurses and sanitarians, the frequency of observations, the bulk and variety of information desired, and the limits of variance that will be acceptable in the final results.

The interval between visits is necessarily short if the objective is to record all unforeseen events resulting in physical injury, as determined by specific signs or symptoms. The householder's memory of minor injuries is limited.

Since this type of study is based on the family, transient visitors are excluded, because the essential data on units of exposure to risk is difficult to obtain. However, visitors in the household who spend a period of time equivalent to the interval between inquiries or accidents are included.

Summary and Conclusions

A case is presented for the inclusion of home accident prevention as a major activity of health departments and physicians. The argument rests upon the accident toll in terms of death, disability, and defect.

Specifically directed prevention based on an understanding of cause has proved effective in communicable disease control and is now being utilized in chronic diseases. The epidemiological method of analysis of multiple causation is a recognized part of the study of mass disease and the practice of public health. It should be recognized equally in the approach to mass injuries as a community health problem.

Several techniques of epidemiological study of home accidents are presented as a means to better understanding of home accident causation, and hence, an improved record in deaths, disabilities, and economic loss for the community.

REFERENCES

- (1) Gordon, J. E.: Accident prevention through epidemiological analysis. To be published in the *Journal of the Michigan State Medical Society*.
- (2) Gordon, J. E.: Home accidents as a community health problem. *Am. J. M. Sc.* 217: 325-344 (1949).
- (3) National Safety Council: Accident facts. Chicago, 1921-51.
- (4) Roberts, H. L., and Gordon, J. E.: Home accidents in Massachusetts. Study in the epidemiology of trauma. *New England J. Med.* 241: 435-441 (1949).
- (5) Roberts, H. L.: A community studies its home accidents. *Am. J. Pub. Health* 41: 1118-1121 (1951).

Ideas

Have You an Idea?

Something new? Different? Better? An easier way to get a job done? A simpler approach? More efficient? Cheaper? Faster?

As a health officer, hospital administrator, nurse, sanitarian, health educator—whatever your position—the day-to-day problems you face more than likely have counterparts in many other places. How you tackle your tasks may be of very real help to others in similar situations. And notes on how they handle their problems may help you.

This "Ideas" section is a place to exchange experiences and approaches. You, as well as your colleagues, will benefit when you send in your ideas.

—THE EDITORS

Council on Mental Health

GEORGIA. An interagency council on mental health has been formed to join avenues of cooperation in meeting mental health needs. The State departments of welfare, education, higher learning, vocational rehabilitation, prisons and corrections, health, employment, and others are usually represented. Participants take turns at being host. Liaison between agencies is discussed and mutual problems shared in the hope that solutions may be worked out more readily.

At one meeting the group worked on a plan for a general statement of their collective mental health needs to be presented to the Citizens' Council and then channeled out to the employees of the organizations represented. In this way, the statement would eventually reach some

20,000 teachers, health workers, and government workers, informing them of the needs and the plans to meet those needs being developed jointly by the official agencies of the State.

Rural School Health

CLINTONDALE, N. Y. A teacher at the Tri-borough School asked a public health nurse for help in including health in her teaching. A public health educator was called in and met with a student-teacher committee. The school's interests were many: safety, good breakfasts, personal hygiene. The students wanted to be "doing things," and a school health program seemed to tie in with 4-H projects in the health field. So Miss Louise Archibald, assistant county 4-H agent, became a part of the planning committee.

Monthly programs began at the school in December. The first meeting concerned nutrition. Films followed by group discussions roused interest. Teachers extended the idea into the classroom along with reading, writing, and arithmetic. The student planning committee decided they would like to prove to themselves that eating the right food pays. Rat feeding demonstrations were begun in the classroom. The program is expanding into all age groups, and the planning group is formulating a long-range health program for their school which will branch out in the community.

Ring Testing in Cattle

MINNESOTA. Three mobile laboratories are being used for a cattle ring testing program in the 53 Minnesota counties not included in the State's "area plan" for controlling brucellosis, or Bang's disease.

The area plan, already operative in the other 34 Minnesota counties, provides for the systematic blood testing of cattle after a petition has been signed by at least 67 percent of a county's cattle owners and accepted by the State livestock sanitary board.

Ring testing is an effective screening device in those counties not under the systematic blood testing plan. The mobile units receive and test milk samples collected from dairy herds without charge to the herd owner. When the ring test is found to be positive, suggesting that brucellosis may be present, owners are advised to have all cattle blood tested individually by veterinarians to discover diseased animals.

So far the program has covered 14 of the 53 counties, and approximately 25 percent of the milk samples tested have suggested the presence of brucellosis.

Not at Home?

OKLAHOMA. In his round of dairy farm inspections, the milk sanitarian cannot always contact the dairyman at the time of inspection to discuss violations. The most effective inspections are those where the sanitarian can discuss first the crops and the weather and then the dairy items needing correction. On nearly half of his inspections, the sanitarian finds that the farmer is either not at home or working in the fields. Often when an inspection is made, and the inspection sheet thumbtacked to the milkhouse wall, the dairyman may not notice it for days. If the sheet is left on the cooler, contrary to the standard milk ordinance, the dairyman or his wife may see it, but it soon becomes lost, possibly before the necessary corrections have been made.

At least one Oklahoma State sanitarian increases the value of his "not-at-home" inspections by using this procedure:

If milkstone is found on milker heads, strainers, pails, or other utensils, this information is noted with a red wax pencil on the outside of the utensil. Notes on half sheets of paper are laid on, or thumbtacked near, such violations as dirty teat cups, a torn screen, or unused equipment stored in the milkhouse. Although the inspection sheet is self-explanatory, there is little or no space for writing in comments or details of violations—but the pin-

pointing of violations makes it easier for the dairy farmer to locate and correct such violations.

Dishwashing Efficiency

CONNECTICUT. A mobile laboratory has been checking dishwashing efficiency in local Connecticut eating places since December 1949 as a part of the State's education program in restaurant sanitation.

The itinerary of the laboratory trailer is planned for several months in advance to coincide with local meetings of restaurant proprietors, their employees, and local health department personnel. The fundamental principles of food sanitation are stressed at the well-attended meetings, which are held in an atmosphere of friendliness. Talks, movies, leaflets on sanitary food handling and cleansing of eating utensils are featured. Displays of actual bacteria growth from samples obtained at local restaurants point home the necessity for cleanliness.

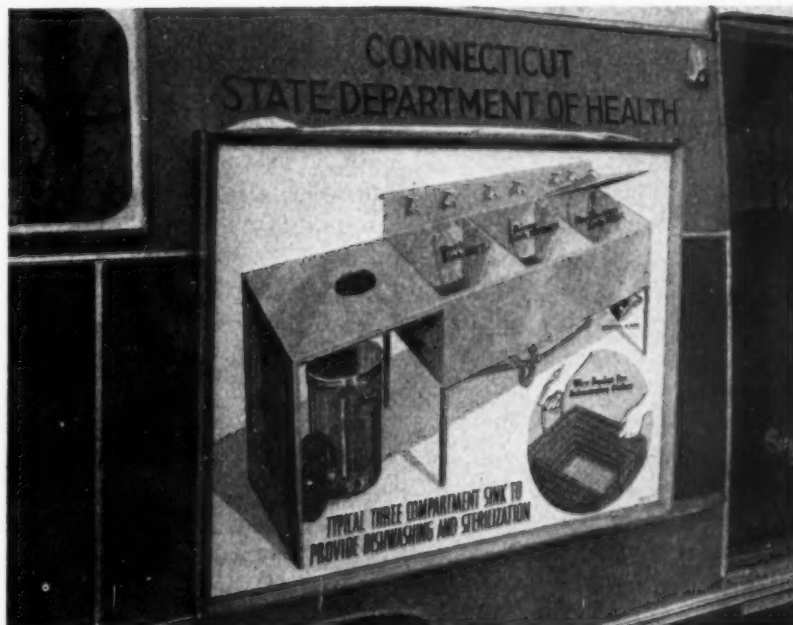
Prior to a meeting, a laboratory technician, working in the trailer, makes a swab test to indicate the number of bacteria on eating utensils. The same tests are part of the routine inspection of each eating establishment when a trailer is located for serving a town.

The swab test is a good index of the efficiency of the washing and bactericidal processes used in a restaurant. A sample is obtained from five swabbings made on five different eating utensils—glasses, cups, cutlery—using a piece of sterile cotton to swab the inside and outside edges of each utensil three times and transferring all bacteria collected to an iced sterile solution. A portion of the sample solution is then tested in the trailer laboratory where an advantage lies in immediate processing before final laboratory testing.

The two photographs on this page of the interior and exterior of the laboratory illustrate two major educational functions it performs as part of the Connecticut restaurant sanitation program: how the technician works at his job; what type of improved equipment the health department recommends.



A bacteria count of swab-test samples obtained from restaurants is made by bacteriologist working in trailer laboratory. Bacteria counts at 98.6° F. are considered satisfactory if below 100. Counts between 100 and 500 are high. Counts over 500 are excessive and call for improved equipment and procedures. The trailer technique provides an advantage by making possible immediate processing before final laboratory testing.



Large side panel on exterior of mobile laboratory illustrates type of sink recommended in the Connecticut restaurant-sanitation program. Other educational aspects of the program stress short conferences for food handlers in towns visited by the laboratory.

State Nursing Surveys and Community Action

By FAYE G. ABDELLAH, R.N., M.A.

During the past 6 years, 35 States and the Territory of Hawaii have used the nursing survey as a tool in analyzing state-wide nursing needs and in alleviating nurse shortages.

Here are some of the major findings revealed by these surveys:

All surveyed States were found to have acute professional nurse shortages and were unable to provide the desirable number of professional nursing hours to patients.

The greatest numerical shortages were found in general hospitals.

The highest need per patient was found in mental and tuberculosis hospitals (see table).

The availability of public health nursing services ranged from none in some communities to adequate coverage in others.

All States revealed that only the very large industrial plant offered nursing services to industrial workers.

Lack of prepared teaching personnel is the most acute problem facing the States. The thin spread of student enrollments throughout the schools suggests an uneconomical use of teaching facilities.

Many students were found to have had no experience in tuberculosis, psychiatric, or public health nursing.

Hospitals, faced with the necessity of providing adequate nursing coverage, have employed many nurses with limited preparation in positions above staff level. Few teaching personnel, public health and industrial nurses were found to have the preparation needed for

their positions. Opportunities to obtain this training were not accessible to nurses who had to carry full-time jobs.

State Surveys Started

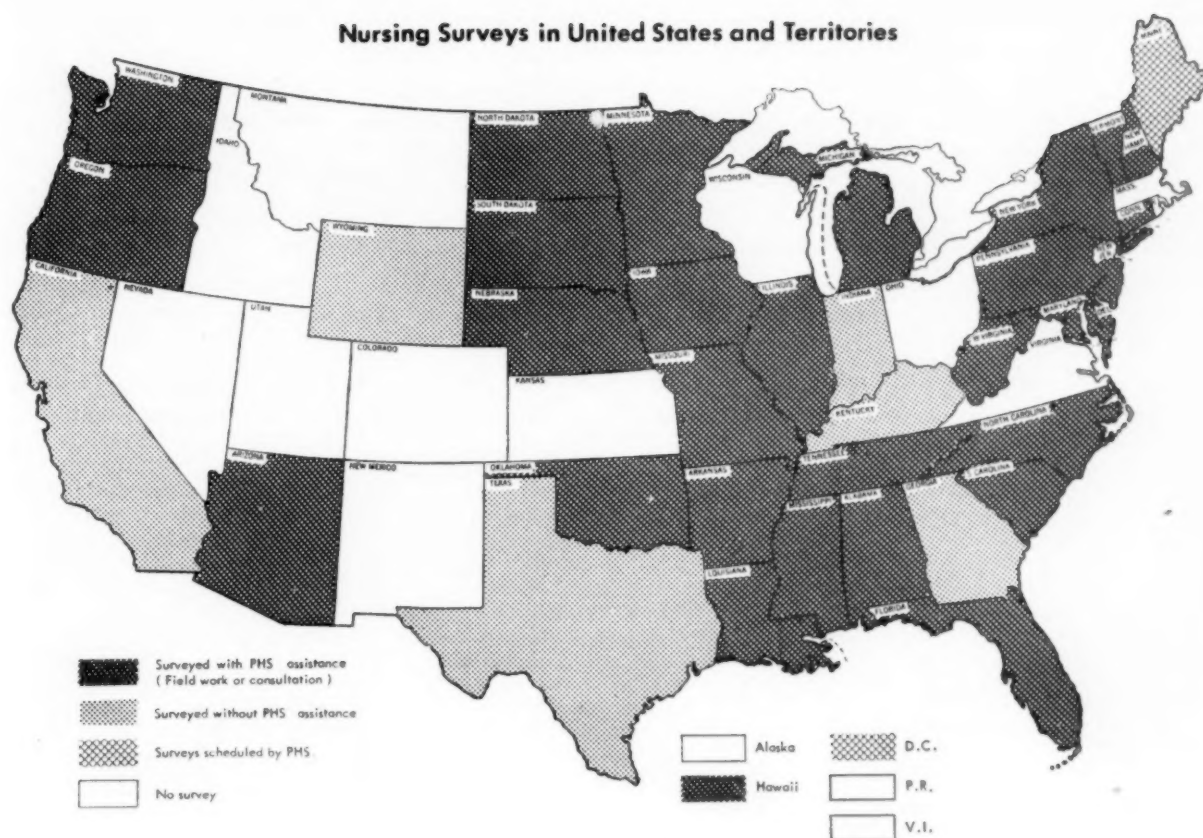
As early as 1946, individual States began to study why the nurse supply has not kept up with the demand and how to meet the nursing needs of the people. Impetus to study state-wide nursing needs was given in 1943 when the National Nursing Council for War Service took the initial step in attacking the problem by appointing a Committee on Domestic Postwar Planning, later to become the National Nursing Planning Committee. It set as its objective the development and distribution of nursing services to the people as well as strengthening nursing education programs (1).

Recognizing the need for these studies, the Public Health Service published a manual in 1949 to guide interested States in conducting nursing surveys (2). The Public Health Service has also directed the field phase of the surveys or provided consultative service in 28 States and in Hawaii. Six other States have conducted nursing surveys without Public Health Service assistance. The accompanying figure identifies these States as well as those where surveys are scheduled.

Only 19 of the States surveyed (with Public Health Service assistance) provided data for analysis. The weaknesses uncovered in these 19 surveys are being attacked by specific programs which have been developed with citizen support following survey recommendations. It was felt that an analysis which would show the steps taken in the surveyed States to find their solutions to nursing problems, as well as addi-

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Nursing Surveys in United States and Territories



tional steps which need to be taken in States only recently surveyed, might be useful in planning similar surveys or follow-up evaluations. Therefore, findings, progress activities, and conclusions are based on the 19 comparable surveys.

Organizing a Survey

The organization set up to operate the surveys was planned around State survey committees. Here a common pattern developed where the individual survey committees conducted the actual surveys which were originated by the State nursing groups alone or jointly with legislative or governors' commissions, State universities, or citizen groups. Members of the committees included representatives from both nursing organizations and such nonnursing groups as medical societies, educational associations, labor organizations, industry, and women's clubs.

No one State followed any one organizational pattern throughout the entire series of surveys.

In Louisiana, for example, nursing organizations formed a Joint Committee for the Improvement of Nursing Services to sponsor its survey and appoint committees in conjunction with the State department of health and the State hospital board.

In 15 States, the State health department joined with State nursing organizations in initiating nursing surveys. South Carolina typifies this joint endeavor. There the State department of health not only sponsored the survey in cooperation with the nursing organizations but also provided office space for the survey director and assigned nurse personnel to participate in the survey.

In some few instances a State university or a women's club initiated a survey. Realizing that the scope of the project would require the services of a full-time director experienced in conducting surveys, these groups sought the assistance of the Public Health Service.

A nurse consultant was assigned by the Division of Nursing Resources of the Public Health Service to assist State committees in

conducting each survey by lending it general direction, supervising the collection of data, and participating in the preparation of the survey report. Nurses in the State took the leadership in organizing committees and in deciding what professional standards to use in estimating needs, and then turned from this organizational phase to the collection of information. Before undertaking the field phase of the survey, the State committees agreed, after discus-

sions, on the specific purposes and emphasis of the survey, and distributed the workload. The final recommendations for action came from these participating committees.

Emphasis of Surveys

All surveys had three major purposes:

1. Determine if there are enough nurses available in each field of nursing practice to meet the needs of the State.

Professional nurse needs, supply and deficits, in hospitals, by type, in 18 States and one Territory following similar survey patterns during survey years, 1946-47, 1948, 1949, and 1950

State ¹	Need ²	Supply ³	Deficit	Percent deficit	State ¹	Need ²	Supply ³	Deficit	Percent deficit
<i>1946-47</i>					<i>1949</i>				
Alabama.....	2,899	1,383	1,516	52	Illinois.....	17,547	9,748	7,799	44
General.....	2,538	1,362	1,176	46	General.....	14,820	(⁴)	(⁴)	(⁴)
Tuberculosis.....	125	11	114	91	Tuberculosis.....	806	(⁴)	(⁴)	(⁴)
Mental.....	236	10	226	96	Mental.....	1,921	(⁴)	(⁴)	(⁴)
Michigan.....	9,669	5,436	4,233	44	Louisiana.....	3,598	2,371	1,227	34
General.....	7,914	5,026	2,888	36	General.....	3,051	2,237	814	27
Tuberculosis.....	1,031	255	776	75	Tuberculosis.....	229	66	163	71
Mental.....	724	155	569	78	Mental.....	318	68	250	79
Mississippi.....	1,605	(⁴)	(⁴)	(⁴)	New Jersey.....	8,098	6,504	1,594	20
General.....	1,288	478	810	66	General.....	6,224	5,773	451	7
Tuberculosis.....	122	(⁴)	(⁴)	(⁴)	Tuberculosis.....	900	323	577	64
Mental.....	195	(⁴)	(⁴)	(⁴)	Mental.....	974	408	566	58
<i>1948</i>					North Carolina.....	3,980	2,684	1,296	32
Minnesota.....	6,935	4,777	2,158	31	General.....	(⁴)	(⁴)	(⁴)	(⁴)
General.....	6,104	4,428	1,676	27	Tuberculosis.....	(⁴)	(⁴)	(⁴)	(⁴)
Tuberculosis.....	421	147	274	65	Mental.....	(⁴)	(⁴)	(⁴)	(⁴)
Mental.....	410	202	208	51	South Dakota.....	(⁴)	1,081	(⁴)	(⁴)
Missouri.....	6,053	2,797	3,256	54	General.....	1,077	1,075	2	0
General.....	5,148	2,675	2,473	48	Tuberculosis.....	(⁴)	4	(⁴)	(⁴)
Tuberculosis.....	392	71	321	82	Mental.....	68	2	66	97
Mental.....	513	51	462	90	Washington.....	6,476	(⁴)	(⁴)	(⁴)
Oregon.....	2,672	1,804	868	32	General.....	5,259	(⁴)	(⁴)	(⁴)
General.....	2,429	1,711	718	30	Tuberculosis.....	844	(⁴)	(⁴)	(⁴)
Tuberculosis.....	78	44	34	44	Mental.....	373	34	339	91
Mental.....	165	49	116	70	<i>1950</i>				
South Carolina.....	2,701	(⁴)	(⁴)	(⁴)	Hawaii.....	1,068	933	135	13
General.....	2,540	(⁴)	(⁴)	(⁴)	General.....	801	827	⁵ 26	⁵ 3
Tuberculosis.....	17	(⁴)	(⁴)	(⁴)	Tuberculosis.....	139	85	54	39
Mental.....	144	(⁴)	(⁴)	(⁴)	Mental.....	128	21	107	84
Tennessee.....	3,038	2,116	922	30	Nebraska.....	2,423	2,009	414	17
General.....	2,660	2,055	605	23	General.....	2,198	1,964	234	11
Tuberculosis.....	88	36	52	59	Tuberculosis.....	40	8	32	80
Mental.....	290	25	265	91	Mental.....	185	37	148	80
<i>1949</i>					Oklahoma.....	2,507	1,560	947	38
Arizona.....	1,238	(⁴)	(⁴)	(⁴)	General.....	2,056	1,537	519	35
General.....	1,047	(⁴)	(⁴)	(⁴)	Tuberculosis.....	129	7	122	94
Tuberculosis.....	58	(⁴)	(⁴)	(⁴)	Mental.....	322	16	306	95
Mental.....	133	11	122	92	West Virginia.....	4,006	2,111	1,895	47
					General.....	3,523	2,068	1,455	41
					Tuberculosis.....	295	24	271	92
					Mental.....	188	19	169	90

¹ The figures for individual States are not additive. ² Needs for nurses are based on standards accepted by the survey committees. These standards vary from State to State so that estimates of needs for the different States are not comparable. ³ Supply data are obtained from State boards of nurse examiner's Registers of Licensed Professional Nurses, from surveys of hospitals, and from surveys of individual nurses. In general hospitals, the supply figures have been adjusted to include the services provided by student nurses. ⁴ Data are missing. ⁵ These figures are excess.

2. Ascertain if the present facilities for nursing education can produce enough well-prepared nurses.

3. Determine if graduate nurses in hospitals, schools of nursing, public health, and industry are trained for the jobs which they are performing.

Other purposes were directed toward finding solutions to such problems in the field of basic professional and graduate nursing education as "Determine if there is a need for establishing a collegiate school of nursing."

Survey Recommendations

Strikingly similar are the recommendations evolving from the surveys. All States including Hawaii stressed the need for additional professional nurses and the need for better prepared professional and nonprofessional nursing personnel. All States stressed broader experience in tuberculosis nursing. Eighteen States wanted more experience in psychiatric nursing for student nurses; 12 stressed centralization of instruction in the basic schools of nursing; 18 stressed the need for workshops, institutes, and extension courses for graduate nurses; and 16 recommended a continuing committee to plan, coordinate, and promote efforts to improve nursing in their States. These were the recommendations which formed the basis for postsurvey study, planning, and action.

In order to promote and carry out the survey recommendations, all of the 19 States formed new committees composed of the original committee members who participated in the surveys. In some cases, new members having special knowledge of the problems requiring solution were included.

Postsurvey Activity

The activity following a nursing survey has varied from State to State. The greatest progress toward achieving survey goals was made in the 13 States where citizens and citizen leaders, in addition to nurses, planned the early stages of the survey and followed through on the postsurvey recommendations. Fifteen States have presented the facts and problems revealed in their surveys to the public, asking for support in finding solutions. Broad com-

munity participation and presentation of the problems to the public have apparently stimulated action following a survey.

Specific progress can be seen in States where problems defined by the survey called for immediate action by nursing groups. For example, in Washington a refresher course has been organized for the 2,700 practical nurses licensed by waiver.

Solutions requiring cooperative action by nursing and other groups take longer to achieve, although achievements of this type have already been recorded. One example is the provision of scholarship assistance for student and graduate nurses by legislatures, and another is the promotion and provision of nursing services for industrial workers in small plants.

Public Health Nurses

The ratio of public health nurses to population is affected by population changes and the total number of public health nurses employed. Twelve of the 19 States not only have increased the number of public health nurses employed but also have increased this number proportionately more than the average for the United States. Four additional States, while increasing the number of public health nurses, have not kept pace with the national rate of increase of public health nurses to population. Three other States have lost public health nurses. In an independent review of State programs by the Public Health Service it is indicated that this loss can be attributed to budget curtailments and to more favorable opportunities opening in other States.

Eleven States, since their nursing surveys, have increased the proportion of public health nurses who had completed one or more years in an approved public health program, and three have surpassed the average relative increase rate for the United States. Three other States show no change since the year of survey.

Five States have a smaller proportion of prepared public health nurses in comparison to the survey year. Three of these States are near or well above the national ratio for 1951 of 35.3 percent of prepared public health nurses. A review of State programs also indicated that some States employ graduates of 3-year schools

on a temporary basis to increase the coverage of public health nurses to population. Many States have increased markedly the total number of public health nurses and are faced with the task of preparing more nurses. When such nurses are given an opportunity to qualify as public health nurses, the total number of prepared public health nurses in these States will increase.

Student Training Widened

Nurses coordinating their efforts with citizen groups have successfully provided broader experience for student nurses in 13 States in the postsurvey periods as shown below:

Total.....	Affiliation Added		
	Rural	Tuberculosis or communicable disease	Psychiatric
Arizona.....	6	7	9
Illinois.....	-----	-----	x
Louisiana.....	-----	-----	x
Michigan.....	x	x	x
Mississippi.....	-----	x	x
Minnesota.....	x	-----	-----
Oklahoma.....	-----	x	-----
Oregon.....	x	x	-----
South Carolina.....	-----	x	x
South Dakota.....	x	-----	x
Tennessee.....	x	x	x
Washington.....	x	-----	-----
West Virginia.....	-----	x	x

Seven States where students formerly were given limited experience in tuberculosis nursing, or none at all, have since their surveys developed new affiliations in tuberculosis nursing or have provided this experience to a larger number of students. In addition, nine States which provided psychiatric nursing experience in mental hospitals out of State can now offer this experience within their borders and extend it to more students.

South Dakota had such a problem. Its survey recommended broader experience for student nurses in psychiatric nursing. The nurses wanted to set up a State hospital affiliation but could not achieve this until the funds were available. So a joint hospital and State committee of nurses and others was organized. Through the committee's well-coordinated efforts, legislation was passed appropriating \$110,000 for the establishment of an affiliate school of nursing at the Yankton State Hos-

pital. Now, for the first time, student nurses in South Dakota can obtain psychiatric nursing experience within their State.

Six States are providing experience in rural hospital community nursing for the first time where only limited field experience in public health nursing had been offered in the past.

Collegiate Schools of Nursing

Of five States recommending the establishment of a collegiate school of nursing, three have actually established these schools, and two other States are in the process of establishing them. One State recommended deferring the formation of a collegiate school of nursing until a sufficient number of faculty and supervisory personnel have been prepared for participation in such a program.

Legislatures Provide Scholarships

One encouraging step the States have taken to increase their nurse supply and to provide graduate nurses with special training is the appropriation of funds for nursing education. Three of the 19 States—Minnesota, Mississippi, and South Dakota—through their legislatures have provided direct financial aid to professional nursing schools or scholarships for students (3).

In 1948 the Mississippi State Legislature appropriated \$60,000 for a nursing education program at the University of Mississippi and in 1950 appropriated \$115,000. Scholarships amounting to \$85,000 were awarded in 1948 to professional registered nurses who wished to obtain advanced preparation in colleges or universities. This appropriation was later increased to \$96,400. To date, 20 of the recipients of the 32 scholarships awarded have returned to Mississippi and are now in administrative and teaching positions; the other 12 are still enrolled in collegiate or university programs. Part of the State appropriation went to employ a full-time instructor for extension courses in ward management and clinical teaching.

New Opportunities for Graduates

Eleven States offering only limited opportunities for postgraduate education have developed new opportunities for graduate nurses to contribute to better patient care as shown here:

Educational Programs

	Extension courses for credit	Work- shops or institutes
Total.....	10	11
Arizona.....	x	x
Florida.....	x	x
Illinois.....	x	x
Louisiana.....	x	-----
Michigan.....	x	x
Mississippi.....	x	x
New Jersey.....	x	x
Oklahoma.....	x	x
South Carolina.....	x	x
Tennessee.....	-----	x
Washington.....	-----	x
West Virginia.....	x	x

Nine States have set up extension courses for credit and workshops or institutes; one has set up extension courses for credit but without a workshop or institute; and two additional States have set up workshops alone.

West Virginia met the problem of improving its schools of nursing by offering a 2-day workshop in "Curriculum Construction and Revision in Schools of Nursing." West Virginia University, the nursing organizations, and the State Health Department all contributed personnel to conduct the workshop. Sixty nurses, representing 11 of the schools of nursing, hospitals, and public health organizations attended. The enthusiastic response to West Virginia's workshop has spurred the development of other workshops and extension courses for graduate nurses in the State.

Arizona is offering for the first time an accredited course in "Principles in Public Health Nursing" which was instituted following the response of 600 active and inactive nurses to a questionnaire poll. Eighty nurses are now enrolled in two centers.

Programs for Practical Nurses

Following nursing surveys, five States set up eight new programs for practical nurse training in public vocational schools. Illinois, Tennessee, and Oklahoma used their survey data successfully in supporting legislation for licensing practical nurses. Legislation for the practical nurse has been recommended in seven other States.

Areas of Future Progress

Too short a time has elapsed since the surveys were completed to permit a measurement

and an evaluation of changes in the total nurse supply and in the number of nurses graduating, receiving postgraduate preparation, or providing part-time service to industry. Post-survey trends can best be analyzed after the data of the years to come have been accumulated. To increase the total nurse supply, to prepare additional nurses for teaching positions, public health and industrial nursing, and to extend nursing services to industry are the goals ahead which need broad community participation for their achievement.

Increasing the Supply

Specific progress in attaining an adequate nurse supply, both quantitative and qualitative, calls for varied but related activities: stepping up nurse recruitment, improving basic schools of nursing, and overhauling personnel policies. Little progress can be achieved by nurses working alone. The 19 surveys have intensified the necessity for joint effort—by laymen and nurses.

Graduation Trends

A longer period of time is necessary for studying graduation trends. In five States where there has been a lapse of three years since the completion of the surveys, the number of nurse graduations is greater than the United States average. But it must be pointed out that admissions to these schools were made prior to the survey year and cannot be attributed directly to the survey. As student withdrawal rates are reduced by the adoption of more selective and better counseling techniques, and the number of admissions remains constant, it can be expected that the increase in graduations will produce a greater nurse supply.

Key Positions

No information is available on the preparation of hospital nurses for positions above staff level. Only five States have collected data in this area. Before any progress can be analyzed, here too, original data must be collected on a continuing basis, as is done in the public health nursing field.

Part-Time Service in Industry

The surveys revealed that 13 States have limited or no nursing services available for the

small industrial plant with 100 or fewer employees. It has been successfully demonstrated that part-time nursing services can be provided by a visiting nurse association or local health department, or by sharing the services of a nurse in more than one plant (4). This is a long-range goal, for when a nurse's services are provided by a local visiting nurse association or department of health, administrative changes in the organization providing part-time nursing service are usually involved. Other factors to be considered are the development of an informational and educational program focused on a better understanding by management and employers of the contribution nurses can make to industry. Contractual arrangements with industrial plants must be worked out and nurses obtained to staff the projects. This too is an area in which citizens and nurses must work together to achieve a common goal.

Conclusions

With the increased demand for nursing services, States analyzed their nursing programs, carefully measured their needs for nursing personnel, and evaluated their educational programs in terms of future nursing services for their communities.

Hospital and nursing administrators have had to plan the number and kinds of nurses required to sustain professional services and to decide whether they were using their staff nurses most effectively.

When the loss every year of many nurses from the profession is coupled with the low admissions and high withdrawal rates in schools of nursing, an even greater challenge faces the nursing profession in meeting the nursing needs of the States. Now is the time for citizens and nurses to continue organizing groups to make comprehensive long-range plans for meeting the nursing needs of the citizens. A state-wide nursing survey provides a basis

for the preparation of a flexible plan for nursing.

As States progress toward survey goals, each forward step contributes to the national nursing picture. As steps are taken to improve the nursing program of one State, no matter how small the program, the nursing profession will benefit. Better and more nursing service for the families and communities of a State will not only improve its level of health but will also increase its share in national production. Greater progress will become more apparent as citizens with widespread interest continue working with nursing organizations on the immediate problems of recruitment, staffing, education, and training.

Much more study must be made of how nurses can work with other groups on related research, including the collection of original data, and of how they can assist in the development of regional and State planning for nursing.

Progress will be made in direct proportion to the degree of unity and agreement which can be achieved by groups sharing a common interest in nursing. A nursing survey can be a constructive device for getting community action. It provides an opportunity for nurses and community representatives to discuss nursing problems by sharing leadership and responsibility. A state-wide nursing survey can thus become a pattern for a comprehensive nursing plan. The action it generates will achieve better health for all.

REFERENCES

- (1) A comprehensive program for nation-wide action. Editorial. *Am. J. Nursing* 45: 707-713 (1945).
- (2) U. S. Public Health Service: Measuring nursing resources. Washington, D. C., 1949.
- (3) State aid to nursing education. Editorial. *Am. J. Nursing* 51: 691 (1951).
- (4) Whitlock, Olive M.: Nursing service for small plants. *Pub. Health Nursing* 33: 732-734 (1941).

Malaria Blood Survey Of Mexican Laborers In an Arkansas County

By L. KARTMAN, Sc.D.
BETTYE M. MAYS, R.N.

Mexicans have been employed as transient agricultural laborers in the Mississippi Delta area since 1925. The number of such workers has been increasing, and the legislation approved in July 1951 (1) concerning the use of Mexican labor in the United States will allow thousands more of these laborers to come into this country every year. In former years, many of these workers were residents of Texas, but recently most of them have been male Mexican nationals coming into the United States from many of the Mexican States. These workers are given medical examinations and are vaccinated against smallpox (2), but examinations of blood films for detection of malarial infections are not routinely performed. Since endemic malaria continues to be reported from many sections of Mexico (3) and since the imported laborers are exposed to large populations of *Anopheles quadrimaculatus* in areas in which they work, it was considered desirable to determine if such persons employed in Phillips County, Arkansas, carried malarial parasites.

Methods

Thick blood films were made from workers in the cotton fields by a three-member survey team. Each group of workers usually had an interpreter. It was possible to call up four or five men at a time, obtain their names, ages, and

Dr. Kartman, an entomologist with the Communicable Disease Center of the Public Health Service and now in charge of the Hawaii Field Station, Honokaa, T. H., previously participated with Miss Mays in a mosquito and malaria investigational project in Arkansas.

other pertinent information, and to make the blood films in about 1 to 2 minutes per man. This was facilitated by having the interpreter or one of the workers act as recorder under the direction of one member of the survey team. The other members of the team made the blood films.

Malarial Survey Findings

A total of 1,038 blood films was obtained on the Mexican nationals from June 5 through July 12, 1951, and 1,022 of these were examined for malarial parasites. These 1,022 represented over 94 percent of the 1,080 Mexican workers under contract with plantations in the Phillips County Cotton Growers Association. The workers contacted represented 24 Mexican States and the Federal District. The majority of these men were between 20 and 35 years of age. An attempt to obtain histories of malaria proved difficult since questions concerning disease or physical disability were generally evaded. Nevertheless, some data were obtained. The table shows the distribution of the men according to the 24 Mexican States from which they migrated and recent malarial morbidity and mortality rates in Mexico.

Five percent of the men gave positive histories of malaria but the blood films were negative for parasites. Obviously the histories of malaria represent a small fraction of the true past positives for malaria among the men surveyed. However, the data in the table indicate that men from Mexican States with higher morbidity and mortality rates gave more positive histories than those from the Mexican States with lower morbidity and mortality rates.

Mexican workers have been shown in the past to constitute a source of malarial infections. However, these records are based primarily on Mexicans living within the United States (4, 5). No past records exist on infections due to malaria of Mexican nationals brought into this country.

Recent Communicable Disease Center malaria appraisal data show that in 1949, 8 cases appraised as positive occurred in Texas among Mexican nationals and in 1950, 13 such cases were identified. Each of these cases occurred as sporadic individual cases; none were known

Distribution of male Mexican nationals by State and by positive malarial history, together with recent malarial rates

State	Number men examined	Positive history		Rates per 100,000 men ¹	
		Number	Percent	Morbidity (1947-51)	Mortality (1948)
Aguascalientes.....	5	0	0	16.9	13.00
Baja California.....	1	0	0	23.9	² 7.70
Campeche.....	1	0	0	198.7	94.66
Chihuahua.....	3	0	0	3.6	2.16
Colima.....	2	0	0	161.4	130.25
Coahuila.....	19	0	0	5.5	2.60
(Mexico) Distrito Federal.....	38	1	2.6	4.4	-----
Durango.....	59	4	6.7	10.8	7.22
Guanajuato.....	201	8	3.9	31.7	6.84
Guerrero.....	19	1	5.2	210.1	154.33
Hidalgo.....	12	1	8.3	111.0	84.68
Jalisco.....	77	3	3.8	29.8	17.28
Mexico.....	53	1	1.8	17.4	7.13
Michoacan.....	210	12	5.7	46.4	28.42
Morelos.....	43	2	4.6	221.5	163.68
Nuevo León.....	35	0	0	31.7	10.35
Oaxaca.....	14	2	14.0	524.9	327.82
Puebla.....	32	1	3.1	212.9	94.51
San Luis Potosí.....	65	7	10.7	189.9	105.18
Sonora.....	1	0	0	37.7	26.29
Tamaulipas.....	11	1	9.0	58.1	34.68
Tlaxcala.....	9	1	11.1	31.2	3.28
Veracruz.....	18	2	11.1	217.8	151.63
Yucatán.....	1	0	0	122.0	48.02
Zacatecas.....	109	6	5.4	23.2	20.26
Total.....	1,038	53	5.1	-----	-----

¹ Supplied by Dr. S. B. Armas, chief of the Malaria Campaign in Mexico, and Dr. C. A. Antunes, assistant director, Pan American Sanitary Bureau.

² Baja California, South Territory.

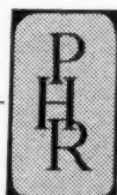
to be identified in groups of two or more, which suggests that they represent relapses of infections acquired in Mexico rather than spread of the infection within the United States.

Summary and Conclusion

In view of the paucity of available records of malaria among the Mexican nationals brought into this country, a blood survey of 1,038 Mexican nationals in Phillips County, Arkansas, was accomplished. The fact that not a single positive blood film was found may suggest that there is little danger of transmissible malaria from these nationals. Nevertheless, as long as many of these workers are recruited from Mexican States from which endemic malaria is reported, it might be advisable for border stations to obtain blood films from individuals who give a recent history of malaria, or who exhibit clinical symptoms of malaria.

REFERENCES

- (1) An act to amend the Agricultural Act of 1949. Public Law 78-82d Cong., 1st sess. Approved July 12, 1951.
- (2) Gregg, R.: Medical examination and vaccination of farm laborers recruited from Mexico. Pub. Health Rep. 65: 807-809 (1950).
- (3) Armas, S. B., et al.: Campana nacional contra el paludismo, 1949. In Mexico memoria of Dep. de salubridad publica. Memoria secret. de salub. y Asistencia, Mexico, D. F.
- (4) Barber, M. A., and Coogle, C. P.: Malaria among Mexican cotton pickers imported into Mississippi. Pub. Health Rep. 42: 1368-1370 (1927).
- (5) Geiger, J. C., and Gray, J. P.: Note on an outbreak of malaria in a railroad camp, Rawson Switch, Calif. Pub. Health Rep. 46: 516-518 (1931).



Small-Quantity Blood Tests for Syphilis

The procedures reported in the five papers that follow have been developed in response to a need for methods of examining the blood of infants for syphilis when it is impracticable to draw the quantities required for standard serologic tests. Also, a technique is needed to mail samples long distances under particularly adverse conditions.

The techniques described present difficulties in securing suitable samples, and in comparative tests all have shown a lower sensitivity than the conventional serologic tests. However, with these techniques, serologic tests for syphilis may be performed on certain patients and under conditions which would completely preclude testing by conventional means. The results suggest the need for further study to determine whether, under special circumstances, the tests may be useful or whether the techniques can be improved.

A Comparison Of Serologic Tests

By **SIDNEY OLANSKY, M.D.**
AD HARRIS, HULDA VINSON, B.S.
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At the direction of the office of the chief, Division of Venereal Disease, Public Health Service, a study to determine the relative efficiency of tests for syphilis requiring small amounts of blood, such as could be collected by finger puncture, was organized. Results of an evaluation of the FPM tests (1) and a preliminary study of the Chediak test (2) have been reported. A modification of the Chediak

test using cardiolipin-lecithin antigen is described in the latter report (page 572 of this issue of *Public Health Reports*).

Study of the Chediak tests has been extended to include several testing centers. The purpose of this article is to present and discuss data and information obtained during this study as they relate to the relative efficiency of: (a) the Chediak test, (b) several modifications of this method for testing dried whole blood, and (c) a micromodification of the VDRL slide test by Cannefax and Johnwick (3) compared with other serologic tests for syphilis performed on heated serum. The laboratories of Dr. R. L. Kahn; Dr. B. S. Kline; Mr. L. Mazzini; the Medical Center, Public Health Service, Hot Springs National Park, Ark.; and the Venereal Disease Research Laboratory, Public Health Service, Chamblee, Ga., participated in this investigation.

Dr. Olansky is director of the Venereal Disease Research Laboratory, Venereal Disease Division, Public Health Service, Chamblee, Ga.; Mr. Harris, assistant director, is in charge of the serology section; Miss Vinson, Mr. Bossak, and Mr. Portnoy are bacteriologists in the serology section—Miss Vinson in the research unit; Mr. Bossak, assistant chief; and Mr. Portnoy, head of the testing unit.

Method

Blood specimens were collected from 360 donors and distributed to the five participating laboratories during the period of the study. This was accomplished by collecting blood from 20 donors (17 to 18 syphilitic patients and 2 or more presumably nonsyphilitic individuals) at the medical centers in Hot Springs, Ark., and Alto, Ga., on Monday of each week and mailing

the specimens to the laboratories. Testing was performed on Thursday of each week in all laboratories so that approximately 72 hours elapsed between collection and testing, even in those instances when the specimens reached the laboratory earlier.

Six vacutainers (10 ml.) of blood were collected from each donor. Blood was immediately removed from the last vacutainer and used to prepare 10 slides, each containing 2 drops (0.05 ml.) of blood, for the Chediak tests, and two capillary tubes for the micro-VDRL slide test. One vacutainer of blood and two slides containing dried blood, from each patient, were sent to each participating laboratory on the day bloods were collected. Capillary tubes of blood were distributed only to the two Public Health Service laboratories.

Each of the five laboratories performed the Chediak test, a modification of the Chediak test using VDRL antigen, and any other modification of the Chediak technique that they might select on the specimens supplied as dried blood on the two glass slides. The tubes of blood supplied serum that was tested quantitatively by any standard method in use at the laboratory. The Medical Center, Hot Springs National Park, Ark., and the Venereal Disease Research Laboratory, Chamblee, Ga., each performed quantitative microtests on the capillary tube specimens, using the micromodification of the VDRL slide test (3).

Antigens for the Chediak test and for those tests employing VDRL antigen were distributed by the Venereal Disease Research Laboratory from common lots. Antigen for the Chediak test had been prepared and was supplied for this study by Dr. Chediak.

Before the survey started, at least one technical worker from each of the testing laboratories was sent to the Venereal Disease Research Laboratory for training in the Chediak and the Chediak-VDRL test techniques. Mr. Canefax visited the Venereal Disease Research Laboratory to demonstrate the micro-VDRL slide test.

The results of all tests were recorded on report forms provided for this purpose and returned to the Venereal Disease Research Laboratory for review and compilation. Final

tabulation and statistical analysis of these findings were made in Washington by the Division of Venereal Disease, Public Health Service.

CHEDIAK TEST

(As described and demonstrated by Dr. A. Chediak)

Reagents:

1. Chediak antigen.
2. 3.5-percent sodium chloride solution.
3. 1-percent sodium carbonate solution.

Equipment:

1. Chediak 3-piece slide holders.
2. 1/4-inch steel bearings.
3. Electromagnet or forceps.
4. Microscope with 60× magnification.

Preparation of Antigen Emulsion:

1. Prepare alkaline saline solution by adding 0.12 ml. of 1-percent sodium carbonate solution to 10 ml. of 3.5-percent sodium chloride solution. Mix well.
2. In one tube (15 x 85 mm.) place 1 ml. of alkaline saline solution.
3. In second tube, place 0.1 ml. of Chediak antigen.
4. Heat both tubes in 56° C. water bath for 5 minutes.
5. Mix by pouring saline into the antigen, and back and forth three times.
6. Place tube containing emulsion in 56° C. water bath for 2 minutes.
7. Check emulsion by examining a drop at 50× to 60× magnification. Particles should be evenly dispersed with no clumping. This emulsion should be used within 5 minutes.

Technique:

1. Place slides on holder, fastening top to make a well around each specimen.
2. Add two 1/4-inch ball bearings to each specimen.
3. Add 0.03 ml. of 3.5-percent sodium chloride solution to each specimen. This may be accomplished by delivering the salt solution from a 0.2-ml. pipette (graduated in 1/100 ml.) or by dropping from a syringe fitted with a 15-gauge needle held in a vertical position. The needle should be tested for delivery of 0.03 ml. of 3.5-percent sodium chloride solution on the day of use.
4. Shake slide holders with irregular motion for 1 minute or until dried blood is resuspended in saline.
5. Add 0.03 ml. of Chediak antigen emulsion with a 0.1- or 0.2-ml. pipette graduated in 0.01 ml.
6. Rotate at 180 rpm for 3 minutes.
7. Remove ball bearings with electromagnet or forceps.
8. Place cover on slide holder and let stand for 20 minutes.
9. Read, using microscope with 60× magnification. Tests should be read within 30 minutes but not prior to 20 minutes after rotation.
10. Report as follows:

Negative	No clumping.
Doubtful	Small clumps.
Positive	Moderate and large clumps.

CHEDIAK-VDRL TEST

Reagents:

1. VDRL flocculation antigen.
2. VDRL buffered saline solution.
3. 3.5-percent sodium chloride solution.

Equipment:

1. Chediak 3-piece slide holders.
2. 1/4-inch steel ball bearings.
3. Electromagnet or forceps.

Preparation of Antigen Emulsion:

1. Prepare and check VDRL antigen emulsion as directed in the *Manual of Serologic Tests for Syphilis* (4).

2. Prepare a diluted VDRL antigen emulsion by adding one part of VDRL buffered saline solution to one part of VDRL antigen emulsion. The diluted emulsion should be allowed to stand 10 minutes before use and should be used within an hour.

Technique:

(Two dried-blood specimens from the same donor are tested simultaneously.)

1. Place slides on holder, fastening top to make a well around each specimen.
2. Add two 1/4-inch ball bearings to each specimen.
3. Add 0.03 ml. of 3.5-percent sodium chloride solution to each specimen. This may be accomplished by delivering the salt solution from a 0.2-ml. pipette (graduated in 1/100 ml.) or by dropping the solution from a syringe fitted with a 15-gauge needle held in a vertical position. On the day of use, the needle should be tested for delivery of 0.03 ml. of 3.5-percent sodium chloride solution.

4. Shake slide holders with irregular motion for 1 minute or until dried blood is resuspended in saline.

5. To one specimen, add 0.03 ml. of VDRL antigen emulsion. To the second specimen, add 0.03 ml. of diluted VDRL antigen emulsion. Emulsions are added with a 0.2-ml. pipette graduated in 0.01 ml.

6. Rotate at 180 rpm for 3 minutes.

7. Remove ball bearings with electromagnet or forceps.

8. Read tests immediately, using microscope with 60X magnification.

9. Report as follows:

Reactive (R)----- Definite clumping of antigen particles.

Nonreactive (N)-- No clumping of antigen particles, or very slight roughness.

NOTE: A test report is the composite of results obtained with diluted and undiluted antigen emulsions. When either result is reactive (although the other may be nonreactive), the report shall be "reactive." When both results are nonreactive, report shall be "non-reactive."

CHEDIAK-KLINE TEST

Reagents:

1. Standard Kline antigen emulsion (cardiolipin-lecithin antigen). Prepare antigen emulsion as di-

rected in *Manual of Serologic Tests for Syphilis* (4a).

2. 2.0-percent sodium chloride solution.

Equipment:

1. Chediak 3-piece slide holders.
2. 1/4-inch steel ball bearings.
3. Electromagnet or forceps.

Technique:

1. Place slides on holder, fastening top to make a well around each specimen.

2. Add two 1/4-inch ball bearings to each specimen.

3. Add 0.06 cc. of 2.0-percent sodium chloride solution to each specimen. This may be accomplished by delivering the salt solution from a 0.2-cc. pipette (graduated in 1/100 cc.) or by dropping two drops from a syringe fitted with a 15-gauge needle held in a vertical position. The needle should be tested for delivery of 0.03 cc. of 2-percent sodium chloride solution on the day of use.

4. Shake slide holders with irregular motion for 1 minute or until dried blood is resuspended in the salt solution.

5. Remove ball bearings with electromagnet or forceps.

6. To each specimen add 1 drop of standard Kline antigen emulsion (0.008 cc.).

7. Rotate at 180 rpm for 4 minutes.

8. Read tests immediately using a microscope with 100X magnification.

9. Report results as with the standard Kline test (*Manual of Serologic Tests for Syphilis* (4b)).

CHEDIAK-MAZZINI TEST

Reagents:

1. Mazzini-cardiolipin antigen (7).
2. Mazzini buffered saline solution.
3. 0.9-percent sodium chloride solution.

Equipment:

1. Chediak 3-piece slide holders.
2. 1/4-inch steel ball bearings.
3. Electromagnet or forceps.

Preparation of Antigen Emulsion (5):

1. Pipette 0.4 ml. of the buffered saline solution to the bottom of a 30-ml. round bottle.

2. With a 1-ml. pipette, measure 0.4 ml. of the cholesterolized antigen (measurement is made from the tip of the pipette). Hold the bottle in the left hand and, imparting a rapid and constant rotating motion to the bottle, add the antigen directly and at once, blowing out whatever antigen is left in the pipette. Draw the emulsion into and out of the pipette exactly six times, returning all the emulsion left in the pipette on the last mixture.

3. Add 2.6 ml. of the buffered saline solution. Cork the bottle with a paraffin-coated cork and shake from bottom of the bottle to cork and back 50 times in 15 seconds.

Technique:

1. Place slides on holder, fastening top to make a well around each specimen.

2. Add two 1/4-inch ball bearings to each specimen.

3. Add 0.03 ml. of 3.5-percent sodium chloride solution to each specimen. This may be accomplished by delivering the salt solution from a 0.2-ml. pipette (graduated in 1/100 ml.) or by dropping the solution from a syringe fitted with a 15-gauge needle held in a vertical position. On the day of use, the needle should be tested for delivery of 0.03 ml. of 3.5-percent sodium chloride solution.

4. Shake slide holders with irregular motion for 1 minute or until dried blood is resuspended in saline.

5. Add Mazzini cardiolipin antigen emulsion from observation tube fitted with 25-gauge needle held at approximately a 45° angle.

6. Rotate at 180 rpm for 4 minutes.

7. Remove ball bearings.

8. Add one drop of 0.9-percent sodium chloride solution from a medicine dropper.

9. Rerotate at approximately 100 rpm for 4 minutes.

10. Read tests immediately.

11. Report as:

Negative..... No clumping.

Weakly positive.... Slight to moderate clumping.

Positive..... Definite clumping.

CHEDIAK-KAHN TEST

Reagents:

1. Kahn standard antigen (lot 140B).

2. 0.9-percent sodium chloride solution.

Equipment:

1. Chediak 3-piece slide holders.

2. 1/4-inch steel ball bearings.

3. Electromagnet or forceps.

Preparation of Antigen Suspension:

1. Same as for standard Kahn test. Prepare antigen emulsion as directed in Manual of Serologic Tests for Syphilis (4c).

Technique:

1. Place slides on holder, fastening top to make a well around each specimen.

2. Add two 1/4-inch ball bearings to each specimen.

3. Add 0.05 ml. of 3.5-percent sodium chloride solution to each specimen. This may be accomplished by delivering the salt solution from a 0.2-ml. pipette (graduated in 1/100 ml.).

4. Shake slide holders with irregular motion for 1 minute or until dried blood is resuspended in saline.

5. Add 0.008 ml. of Kahn antigen suspension with a 0.1-ml. pipette graduated in 0.001.

6. Rotate at 180 rpm for 3 minutes.

7. Remove ball bearings with electromagnet or forceps.

8. Read tests immediately, using microscope with 60× magnification.

9. Report as follows:

Negative..... No clumping.

Doubtful..... Small clumps.

Positive..... Moderate and large clumps.

MICRO-VDRL SLIDE TEST (CANNEFAX)

This test is described in detail in "A Micromodification of the VDRL Slide Test," by Cannefax, Beyer, and Johnwick, on page 576 of this issue of *Public Health Reports*.

Results

Only qualitative test results obtained in the five laboratories with each test procedure are recorded in tables 1-5 since quantitative results are not obtained by any of the Chediak procedures. Qualitative test findings offer a basis for comparison of testing efficiency if only the ability of a test to react in a weakly or strongly positive manner with specimens from syphilitic donors is considered. This ability to "detect" serologically positive blood specimens is important if the tests requiring only small-volume

Table 1. Results obtained on whole blood and on dried blood specimens tested in the Venereal Disease Research Laboratory, Chamblee, Ga.

Tests	307 syphilitic donors					45 presumably nonsyphilitic donors				
	Positive	Weakly positive or doubtful	Negative	Not tested	Percent reactive	Positive	Weakly positive or doubtful	Negative	Not tested	Percent negative
On serum:										
Kahn standard.....	284	17	6	-----	98	0	2	43	-----	95.6
VDRL slide.....	286	14	7	-----	97.7	0	0	45	-----	100
Micro-VDRL slide.....	228	34	21	24	92.6	2	7	33	3	78.6
On dried blood:										
Chediak.....	64	135	108	-----	64.8	0	12	33	-----	73.3
Chediak-VDRL.....	Reactive 266		41	-----	86.6	Reactive 3		42	-----	93.3

blood collection, such as the Chediak test, are used for screening child or baby groups for congenital or acquired infections.

The results of tests on specimens from eight of the presumably nonsyphilitic blood donors used in this study were omitted from final tabulation because other than negative reactions were obtained on the whole-blood sample tested by one or more author serologists, and adequate information regarding the clinical status of these individuals could not be obtained. Only the author's test, as performed in his laboratory, was considered in this regard. Positive or weakly positive (doubtful) reactions were produced by five of these specimens in the Mazzini

test, six in the VDRL slide test, three in the Kline test, and two in the Kahn test.

Results of the Chediak and Chediak-VDRL tests, as reported by the five laboratories, are compared with the quantitative VDRL slide test findings in tables 6 and 7. These tables present the zones of relative agreement between the tests on dried blood specimens and the VDRL slide test in terms of quantitation. The VDRL slide test results used in these tables were those reported by the Venereal Disease Research Laboratory.

Reports of the Chediak and Chediak-VDRL test results from the five laboratories on dried blood specimens from 45 presumably nonsyph-

Table 2. Results obtained on whole blood and on dried blood specimens tested in the laboratory of the Public Health Service Medical Center, Hot Springs National Park, Ark.

Tests	307 syphilitic donors					45 presumably nonsyphilitic donors				
	Positive	Weakly positive or doubtful	Negative	Not tested	Percent reactive	Positive	Weakly positive or doubtful	Negative	Not tested	Percent negative
On serum:										
Kahn standard.....	275	9	23	-----	92.5	0	0	45	-----	100
Kolmer complement-fixation.....	250	6	38	4	87.5	0	0	44	1	100
VDRL slide.....	270	11	26	-----	91.5	0	0	45	-----	100
Micro-VDRL slide.....	273	11	23	-----	92.5	1	0	44	-----	97.8
On dried blood:										
Chediak.....	145	88	74	-----	75.9	3	4	38	-----	84.4
Chediak-VDRL.....	Reactive 272		35	-----	88.6	Reactive 4		41	-----	91.1

Table 3. Results obtained on whole blood and on dried blood specimens tested in Dr. Kahn's laboratory

Tests	307 syphilitic donors					45 presumably nonsyphilitic donors				
	Positive	Weakly positive or doubtful	Negative	Not tested	Percent reactive	Positive	Weakly positive or doubtful	Negative	Not tested	Percent negative
On serum:										
Kahn standard.....	276	7	24	-----	92.2	0	0	45	-----	100
Kahn presumptive.....	298	1	7	1	97.7	2	1	42	-----	93.3
On dried blood:										
Chediak.....	203	36	68	-----	77.9	10	9	25	1	56.8
Chediak-Kahn.....	229	13	31	34	88.6	20	5	14	6	35.9
Chediak-VDRL.....	Reactive 278		23	6	92.4	Reactive 29		14	2	32.6

ilitic donors are listed in table 8. Specific disagreements are noted in the footnotes to this table.

Discussion

The Chediak test as performed in the Venereal Disease Research Laboratory (table 1) was appreciably less sensitive than the other tests for syphilis, producing positive or doubtful reactions in approximately two-thirds of the specimens from syphilitic donors that gave those reactions in the other tests. The rela-

tive percentage reactivity of the Chediak test on specimens from syphilitic donors was not the same in each laboratory. The percentages ranged from 60.8 percent (Kline laboratory, table 4) to 77.9 percent (Kahn laboratory, table 3) as compared with the standard flocculation test results on serum which ranged between 91.5 percent (VDRL slide test, table 2) and 98.7 percent (Mazzini-cardiolipin test, table 5) and the Kolmer complement-fixation test result of 87.5 percent (table 2). These findings indicate that the Chediak test detected 70 to 80 percent of the syphilitic donors in this study whose

Table 4. Results obtained on whole blood and on dried blood specimens tested in Dr. Kline's laboratory

Tests	307 syphilitic donors					45 presumably nonsyphilitic donors				
	Positive	Weakly positive or doubtful	Negative	Not tested	Percent reactive	Positive	Weakly positive or doubtful	Negative	Not tested	Percent negative
On serum:										
VDRL slide flocculation	281	11	15	-----	95.1	0	0	45	-----	100
Kline standard	286	12	9	-----	97.1	0	0	45	-----	100
Kline diagnostic	269	18	20	-----	93.5	0	0	45	-----	100
Kline exclusion	293	6	8	-----	97.4	0	1	44	-----	97.8
On dried blood:										
Chediak	98	77	113	19	60.8	1	6	37	1	84.1
Chediak-Kline	226	30	32	19	88.8	0	0	44	1	100
Chediak-VDRL	Reactive 242		46	19	84.3	Reactive 0		44	1	100

Table 5. Results obtained on whole blood and on dried blood specimens tested in Mr. Mazzini's laboratory

Tests	307 syphilitic donors					45 presumably nonsyphilitic donors				
	Positive	Weakly positive or doubtful	Negative	Not tested	Percent reactive	Positive	Weakly positive or doubtful	Negative	Not tested	Percent negative
On serum:										
VDRL slide	273	25	9	-----	97.1	0	1	43	1	97.8
Mazzini (cardiolipin)	285	18	4	-----	98.7	0	0	44	1	100
Mazzini (lipoidal)	251	15	6	35	97.8	0	2	37	6	94.9
On dried blood:										
Chediak	134	96	71	6	76.4	5	7	33	-----	73.3
Chediak-Mazzini	228	38	35	6	88.4	0	4	41	-----	91.1
Chediak-VDRL	Reactive 275		29	3	90.5	Reactive 7		38	-----	84.4

blood gave positive or doubtful reactions in standard tests for syphilis using serum.

The modified Chediak test using VDRL test antigen, and referred to as the Chediak-VDRL test, was the only modification of the Chediak test performed by all five participating laboratories. This technique called for reporting results as "reactive" and "nonreactive" so that all reactions equivalent to positive and doubtful or weakly positive are included under

the "reactive" heading. In each laboratory, this test was more reactive on specimens from syphilitic donors than was the Chediak test. The Chediak-VDRL test showed reactivity percentages of 86.6, 88.6, 92.4, 84.3, and 90.5, respectively, and a reactivity percentage of 88.5 percent for all laboratories. These figures show a closer relationship with test results obtained by serum tests since approximately 90 percent of the reactors in the specimens from

Table 6. Results obtained by five laboratories with the Chediak test compared with quantitative VDRL slide test findings on specimens from 307 syphilitic donors

Chediak test	Quantitative VDRL slide test (dils)												Total
	Negative	<1	1	2	4	8	16	32	64	128	256	512	
Reactive in:													
5 laboratories.....	1		1	12	12	19	17	12	11	3	1		89
4 laboratories.....		4	4	6	7	12	16	10	6	2	1	1	69
3 laboratories.....	2	2	4	7	4	9	5	12	8	3			56
2 laboratories.....	3	3	4		6	3	7	5	4	4	2	1	42
1 laboratory.....	1	4	1	3			1	7	1	3	2		23
Negative in all 5 laboratories.....			1		1			1					3
Total.....	7	13	15	28	30	43	46	47	30	15	6	2	282
Not tested in all 5 laboratories.....		1	6		3	4	7	1	2		1		25
Grand total.....	7	14	21	28	33	47	53	48	32	15	7	2	307

NOTE: Agreement in 5 laboratories..... 92 (32.62 percent)

Partial agreement (agreement in 4 laboratories; disagreement in 1)..... 92 (32.62 percent)

Partial disagreement (disagreement in 3 laboratories; agreement in 2)..... 98 (34.75 percent)

Total specimens tested in all 5 laboratories..... 282

Table 7. Results obtained by five laboratories with the Chediak-VDRL test compared with quantitative VDRL slide test findings on specimens from 307 syphilitic donors

Chediak-VDRL test results	Quantitative VDRL slide test (dils)												Total
	Negative	<1	1	2	4	8	16	32	64	128	256	512	
Reactive in:													
All 5 laboratories.....			1	15	22	41	41	43	28	7	4	1	203
4 laboratories.....		3	5	8	7	3	2	2	1	3			34
3 laboratories.....	1	2	3	2			2			3	1		14
2 laboratories.....	2	3	3	1	1						1		11
1 laboratory.....	3	3	3				1			2			12
Negative in all 5 laboratories.....	1	2	1									1	5
Total test.....	7	13	16	26	30	44	46	45	29	15	6	2	279
Not tested in all 5 laboratories.....		1	5	2	3	3	7	3	3		1		28
Grand total.....	7	14	21	28	33	47	53	48	32	15	7	2	307

NOTE: Total agreement (5 laboratories)..... 208 (74.55 percent)

Partial agreement (agreement in 4 laboratories; disagreement in 1)..... 46 (16.49 percent)

Partial disagreement (disagreement in 3 laboratories; agreement in 2)..... 25 (8.94 percent)

Total specimens tested in all 5 laboratories..... 279

Table 8. Results obtained by five laboratories with the Chediak and Chediak-VDRL tests on specimens from 45 presumably nonsyphilitic donors

Results	Chediak test	Chediak-VDRL test
	Number of specimens	Number of specimens
Negative in:		
All 5 laboratories.....	13	12
4 laboratories.....	¹ 16	² 22
3 laboratories.....	³ 7	⁴ 7
2 laboratories.....	⁵ 4	0
1 laboratory.....	⁶ 2	⁷ 1
No laboratory.....	1	0
Not tested in 1 or more laboratories.....	2	3
Total tested in all 5 laboratories.....	43	42

NOTE: Number of reactors in each laboratory was:

¹ Kahn, 7; Mazzini, 5; Hot Springs, 1; Venereal Disease Research Laboratory, 3.

² Kahn, 20; Hot Springs, 2.

³ Kahn, 6; Kline, 2; Hot Springs, 2; Venereal Disease Research Laboratory, 2.

⁴ Kahn, 7; Mazzini, 6; Venereal Disease Research Laboratory, 1.

⁵ Kahn, 3; Mazzini, 3; Venereal Disease Research Laboratory, 3; Kline, 2; Hot Springs, 1.

⁶ Kahn, 2; Kline, 2; Venereal Disease Research Laboratory, 2; Hot Springs, 1; Mazzini, 1.

⁷ All laboratories except Kline, 1.

the syphilitic donor group, with all tests, were detected by this method. Inspection of the reactivity percentage figures for each test (tables 1-5) shows that an even closer agreement exists between the Chediak-VDRL test and the selected single testing procedures.

The third group of tests performed on dried blood samples included the Chediak-Kahn, Chediak-Kline, and Chediak-Mazzini tests using the respective antigens designated by the latter names. These tests showed reactivity ratings of 88.6 percent, 88.8 percent, and 88.4 percent, respectively, so the ability of these tests to produce positive or doubtful reactions on the specimens from syphilitic donors appears to be about the same as the Chediak-VDRL test.

The relative specificity of these tests on dried blood is not so clear from the reported findings. The number of positive plus doubtful reactions obtained by the Chediak method on the dried blood samples from presumably nonsyphilitic donors as recorded in tables 1-5 are 12, 7, 19, 7,

12, with an average of 11.4, yielding an over-all specificity rating of approximately 75 percent. However, it is noted that the largest number of these reactions were obtained in one laboratory (table 3) that also reported only 14 negative reactions on this group of specimens from presumably nonsyphilitic donors using the Chediak-Kahn and Chediak-VDRL procedures. This may indicate that the dried blood samples tested by this laboratory were either not similar, at the time of testing, to those tested in the other laboratories or that technical difficulties prevented the obtaining of clearly negative reactions at this testing station.

The Chediak-VDRL modification, as performed in the five laboratories, failed to give negative findings in 3, 4, 29, 0, and 7 instances, respectively, in the "negative" (presumably nonsyphilitic) donor group as recorded in tables 1-5. The lack of agreement between laboratories is greatest in this group of reports, so an average of findings under these circumstances probably would have little significance. The major disagreement in this regard was also from a single laboratory (table 3).

The results recorded in tables 1, 2, 4, and 5 show, in each instance, that the modifications of the Chediak test (Chediak-VDRL, Chediak-Kline, Chediak-Mazzini) had better sensitivity and specificity ratings than the original Chediak test performed at the same time in the four laboratories. These four tests employed cardiolipin-lecithin antigens. In the fifth instance (table 3), the two modified Chediak tests (Chediak-Kahn and Chediak-VDRL) were more reactive than the original Chediak test. However, all three of these tests had very poor specificity ratings. Findings reported by all five laboratories indicate that the Chediak test, modified to use cardiolipin-lecithin antigens, may be operated at a more efficient level than the original Chediak test as a "detector test" for syphilis. Evidence acquired during this study shows no definite preference for any one of the cardiolipin antigens used (Kline, Mazzini, VDRL).

Comparative reproducibility of the Chediak and Chediak-VDRL tests as portrayed in tables 6 and 7 favors the latter test. Complete agreement between results obtained in all five laboratories is more than twice as great with the Chediak-VDRL test (74 percent as opposed to

32 percent) and approximately 90-percent agreement was obtained by four of the five laboratories using this test. This indicates that a favorable percentage of agreement may be expected from laboratories performing the Chediak-VDRL test without lengthy technician training periods. However, these findings also may reflect less variability in antigen emulsions used from time to time in the several laboratories rather than a direct human variable such as ability to conduct tests or read results. The VDRL antigen emulsion is more stable and may be used for a longer time after being prepared than the Chediak antigen emulsion.

The micro-VDRL slide test results reported by two laboratories (tables 1 and 2) were in close agreement as to reactivity on specimens from syphilitic donors showing that 92.6 percent and 92.5 percent, respectively, of the specimens tested gave positive or weakly positive findings. However, 9 of 42 specimens from the nonsyphilitic donor group were reported by the Venereal Disease Research Laboratory as positive or weakly positive with the micro-VDRL test and only one positive reaction was reported by the Medical Center laboratory on 45 specimens from the same group.

It was also noted that 27 (8 percent) of the 352 specimens (307 from syphilitic donors, and 45 from presumably nonsyphilitic donors) submitted in capillary tubes for the micro-VDRL test were not tested at the Venereal Disease Research Laboratory while reports of microtest results were issued on all 352 such specimens by the Medical Center laboratory. The 27 specimens listed under the "not tested" heading for the micro-VDRL test by the Venereal Disease Research Laboratory were untestable due to loss of serum either in transit or in the centrifuge, or due to breakage of the capillary tube in the centrifuge. These factors are not evident in the reports of this test by the Medical Center laboratory because serum from the vacutainer tubes was used for testing whenever the capillary tube specimen was lost through leakage or breakage. The number of these losses that occurred is not recorded.

The relative efficiency of a testing procedure is based not only on test specificity and sensitivity but also on the effectiveness with which an

adequate specimen can be obtained and delivered to the laboratory. Loss of serum by breakage or leakage of tube in transit or through normal handling in the laboratory weighs against the micro-VDRL slide test procedure if the experience of the Venereal Disease Research Laboratory in this study indicates the average expectancy for adequate specimens to be received in the laboratory. A loss of 8 percent of the specimens submitted reduces collection rates to at least 92 percent, if an adequate specimen could be obtained from every donor. However, since the capillary tube is essentially similar to the large blood tubes, it is probable that deterioration of the blood sample in the capillary tube would not be more rapid than if collected in a larger tube.

The micro-VDRL slide test provides for quantitation if an adequate blood sample is collected. This would require approximately 0.15 ml. of blood, an advantage over the tests on dried blood specimens that do not provide for quantitation.

Findings reported in this study indicate that the Chediak test modifications using cardiolipin-antigens and the micro-VDRL slide test would be approximately equally effective as "detector tests" for syphilis. The modified Chediak tests detected approximately 90 percent of the specimens that gave positive reactions in other tests when performed on 72-hour-old blood samples. Previous studies have shown that dried blood samples are more reactive when stored for shorter periods of time. The 8-percent loss of capillary blood specimens for the micro-VDRL slide test placed this test in a comparable position with the Chediak modifications.

A field study of these two types of collection and testing procedures would be needed to determine the method of choice. Several factors that may influence this selection are (a) type of donor group, whether adult, child, or infant, (b) time interval between blood collection and testing, and (c) capability of the laboratory to perform either test efficiently.

Summary

1. Results obtained in five laboratories with the Chediak test and its modifications on dried

blood specimens plus several other tests on heated serum are presented.

2. The relative reproducibility of the Chediak and Chediak-VDRL tests among the five participating laboratories is shown in tabular form and is discussed.

3. Relative efficiency of the tests on dried blood specimens, as compared to tests on heated serum as "detector" tests for syphilis is discussed.

4. The micro-VDRL slide test findings, as reported by two laboratories, are presented and compared with results of other testing procedures.

REFERENCES

- (1) Harris, A., Olansky, S.: A study of the filter paper microscopic (FPM) test for syphilis. Preliminary report. *J. Ven. Dis. Inform.* 32: 1-4 (1951).
- (2) Harris, Ad, Vinson, Hulda, Olansky, Sidney: A study of the Chediak test. *Pub. Health Rep.* 67: 572-576 (1951).
- (3) Cannefax, G. R., Beyer, H. R., and Johnwick, E. B.: A micromodification of the VDRL slide test. *Pub. Health Rep.* 67: 576-581 (1952).
- (4) U. S. Public Health Service: Manual of serologic tests for syphilis. Supplement No. 22, *J. Ven. Dis. Inform.*, 1949, p. 110; (a) *Ibid.*, p. 68; (b) *Ibid.*, p. 69; (c) *Ibid.*, pp. 38-39.
- (5) Mazzini, L. Y.: Mazzini cardiolipin microflocculation test for syphilis. *J. Immunol.* 66: 261-275 (1951).

The Chediak Test— A Preliminary Report

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The development of a test for syphilis requiring only a small amount of blood that could be collected with a minimum of equipment and difficulty by relatively untrained personnel has been the object of several investigative studies (1-9). Such a test would aid considerably in the detection of cases of syphilis from

which collection of the amounts of blood necessary for the standard testing procedures, using serum, is difficult or impractical due to lack of either adequate facilities or adequately trained workers.

In 1932 Dr. Alejandro Chediak of Havana, Cuba, published a technique for the serodiagnosis of syphilis requiring the collection of only a single drop of blood. The Venereal Disease Research Laboratory has recently studied this method as it was demonstrated by Dr. Chediak and explained in a personal communication from him. The purpose of this presentation is to report results obtained with the Chediak test and modifications of this technique using cardiolipin-lecithin antigens, under specified conditions.

CHEDIAK TEST

The mechanics of the Chediak test were retained with only minor changes throughout this study, using equipment and antigen supplied by Dr. Chediak. A brief summary of this method as demonstrated by Dr. Chediak during a visit to the Venereal Disease Research Laboratory, follows:

1. A drop of dried, "homogenized" blood, collected on a glass slide, is resuspended in 0.03 ml. of 3.5-percent sodium chloride solution. This is accomplished by placing the slide in a slide holder that forms a well above the blood sample so that two ¼-inch steel balls may be put into each blood-saline mixture. The blood is then dissolved or resuspended by rotating the slide holder for approximately 1 minute.

2. After 0.03 ml. of antigen emulsion is added to each specimen, the specimens are rerotated on a flat-bed rotator for 3 minutes at 180 rpm.

3. Steel balls are removed, glass covers are placed into slide holders to prevent drying, and specimens are allowed to stand 20 to 30 minutes before being examined.

4. Slide holder covers are removed and specimens are read with a microscope at 60× magnification. Small clumps of antigen particles are interpreted as a doubtful reaction, large clumps indicate a positive reaction, and no clumping of antigen particles is read as a negative reaction.

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The original Chediak antigen used in this test is a cholesterolized alcoholic extract of beef heart to which Tolu and Peru balsams have been added.

MODIFIED CHEDIAK TECHNIQUE (CHEDIAK-VDRL TEST)

I. Reagents:

1. VDRL flocculation antigen (10).
2. VDRL buffered saline solution (10).
3. 3.5-percent sodium chloride solution (prepared by dissolving 3.5 gm. dry sodium chloride in 100 ml. freshly distilled water).

II. Equipment:

- *1. Chediak 3-piece holders.
- *2. ¼-inch steel ball bearings.
- *3. Electromagnet or forceps.

III. Preparation of Antigen Emulsion:

1. Prepare and check VDRL antigen emulsion as directed on page 110 of the Manual of Serologic Tests for Syphilis, Supplement 22 to the Journal of Venereal Disease Information.
2. Prepare a diluted VDRL antigen emulsion by adding 1 part of VDRL buffered saline solution to 1 part of VDRL antigen emulsion. This diluted emulsion should be allowed to stand 10 minutes before use and should be used within 1 hour.

IV. Technique:

- *1. Place slides on holder, fastening top to make a well around each specimen.
- *2. Add two ¼-inch ball bearings to each specimen.
- *3. Add 0.03 ml. of 3.5-percent sodium chloride solution to each specimen. This may be accomplished by delivering the solution from a 0.2-ml. pipette (graduated in 0.01 ml.) or by dropping from a syringe fitted with a 15-gauge needle held in a vertical position. The needle should be tested for delivery of 0.03 ml. of 3.5-percent sodium chloride solution on the day of use.
- *4. Shake slide holders with an irregular motion for 1 minute or until dried blood is resuspended.
5. Add to each specimen 0.03 ml. of diluted VDRL antigen emulsion from a 0.2-ml. pipette graduated in 0.01 ml.
- *6. Rotate at 180 rpm for 3 minutes.
- *7. Remove ball bearings with electromagnet or forceps.
8. Read tests immediately, using microscope with 60× magnification.
9. Report as follows:

Reactive-----	Definite clumping of antigen particles.
Nonreactive-----	No clumping of antigen particles.

NOTE: All items marked with an asterisk are identical with those in the Chediak test.

Collection of Blood Specimens

Dried blood specimens were collected on 3- x 1-inch glass slides with frosted ends. An identifying number was written in pencil on the frosted portion of the slide. In this way the blood sample and identification were never separated from time of collection until testing was completed.

Slides were ringed on the reverse side with a wax pencil so that the dried blood specimen would coincide with the well formed when the slide was placed in the plastic slide holder. A drop of blood, obtained by puncturing a finger, toe, or heel with an automatic spring-type lancet, was allowed to fall onto the ringed portion of a properly labeled slide. The blood was then "homogenized" by stirring with an applicator stick for ½ to 1 minute.

Multiple slides of dried blood specimens and venipuncture blood samples for serum tests were collected simultaneously for comparative testing.

Procedure

In the first series of specimens tested with a cardiolipin-lecithin antigen an attempt was made to keep the reagin-antigen-particle ratio approximately the same as in the VDRL slide test. Since the dried blood was resuspended in 0.03 ml. saline (approximately one-half the 0.05 ml. serum of the standard test) the dose of antigen was reduced to a drop equivalent to ⅓ ml. Rapid drying of these preparations during the rotation period rendered them unsatisfactory. To increase the amount of fluid and maintain the same reagin-antigen-particle ratio, the VDRL antigen emulsion was diluted in the proportion of 1 part of antigen emulsion to 3 parts of VDRL buffered saline solution and the dose of this diluted emulsion was set at 0.03 ml. With this combination, results approximately equal in sensitivity to those produced by Chediak antigen were obtained.

A second series of tests using 0.03 ml. of antigen emulsion, containing equal parts of VDRL antigen emulsion and buffered saline solution, gave fewer negative reactions in specimens from syphilitic donors than did other antigen-saline combinations tested. For this reason, this type of antigen emulsion was selected for the Chediak-VDRL test. Another advantage of the diluted VDRL antigen over the Chediak antigen, in the Chediak test, is that reactions were more rapid so that, when the VDRL antigen was used, the 20-minute waiting period of the Chediak test could be discarded, and reactions

could be read immediately after the 3-minute rotation period.

Attempts to further increase sensitivity by increasing the concentration of the sodium chloride solution used for resuspension of the dried blood resulted in crystallization of sodium chloride, which interfered with readings. Prolongation of the rotation time increased sensitivity but also produced very rough negative and weakly positive reactions on known negative donors. Several cardiolipin-lecithin antigens other than the one for the VDRL slide test were employed in varying dilutions without obtaining an increase in test sensitivity.

In order to determine the effect of storage on dried blood samples, multiple specimens were collected from unselected patients undergoing treatment for syphilis. These specimens were stored at room temperature for varying periods of time before being tested. Results obtained with the Chediak and Chediak-VDRL tests on dried blood specimens stored for 24 and 72 hours are listed in table 1.

Duplicate dried blood specimens and whole-blood specimens in vacutainers were simultaneously collected from a selected group of patients. These specimens were used to determine the relative capacities of the two tests on

dried blood to detect those donors whose serum produced positive or weakly positive reactions in the VDRL slide test. Results obtained in this comparison are recorded in table 2.

Effect of Storage on Dried Blood Specimens

Several dried blood samples were collected from each of a group of patients under treatment for syphilis in order to determine the effect of storage on this type of blood sample. These specimens were tested after storage at room temperature for 24 hours, 72 hours, and longer periods.

Some deterioration in reactivity was noted at all storage periods greater than 24 hours, and the longer storage periods produced the greatest loss in reactivity. However, since 72 hours was the shortest time that could be used for interlaboratory studies involving shipment of specimens to distant parts of this country and since this period would also be considered maximum for studies conducted by a single laboratory with state-wide blood collections submitted by mail, attention was specifically directed to the effect of this much delay between collection and testing on dried blood specimens.

Results presented in table 1 show that fewer "negative" reactions were obtained by both techniques at the earlier testing period and that a greater loss of reactivity was noted in Chediak test results on specimens stored for 72 hours than in the findings of the Chediak-VDRL test. The number of specimens used in this series is too small to indicate definite sensitivity positions of the tests used but they do serve as an indicator of relative test behaviors.

Storage conditions were not unusually humid during this study. To ascertain the effects of humidity on the dried blood samples during a storage period, several collections were placed in a glass jar over water, at room temperature. Under these conditions the blood specimens stored for 24 or more hours were unsatisfactory for testing due to presence of gross debris that did not redissolve in the saline.

Comparison of Results With Two Techniques

A series of specimens from 196 donors was tested, using the Chediak and Chediak-VDRL

Table 1. Effect of storage at room temperature on reactivity of dried blood specimens from 67 donors

Reactivity after 72 hours' storage	Reactivity after 24 hours' storage			
	Chediak test			
	Positive	Doubtful	Negative	Total
Positive.....	5	1	0	6
Doubtful.....	8	6	5	19
Negative.....	6	11	25	42
Total.....	19	18	30	67
	Chediak-VDRL test			
	Reactive	Nonreactive	Totals	
Reactive.....	47	1	48	
Nonreactive.....	5	14	19	
Total.....	52	15	67	

techniques. Blood specimens collected by venipuncture at the same time were tested, using the VDRL slide test. The results obtained are presented in table 2.

One blood specimen that gave a negative reaction in the VDRL slide test had a positive Kahn test (32 units) and a 1 plus reaction in the Kolmer test. This specimen was positive in the Chediak test and reactive in the Chediak-VDRL test. The nine specimens that gave negative reactions in the VDRL slide test were also negative with both the Kahn and Kolmer tests. The remainder of these serums that gave positive reactions in the VDRL slide test also gave doubtful or positive reactions in either or both the Kahn and Kolmer tests.

Although the Chediak test gave positive or doubtful reactions on a few specimens that were reported nonreactive by the Chediak-VDRL procedure, 88 negative reactions were reported by the Chediak method and only 47 nonreactive results were obtained with the Chediak-VDRL test. The greatest discrepancy, in this regard, was found in the specimens of higher titer.

The highest percentage failure of the Chediak-VDRL to detect specimens that reacted in the VDRL slide test existed in those having 4 dils or less reactivity. In this zone, 39 of 65 VDRL slide test reactors were detected and in the group having more than 4 dils reactivity 109 of 121 reactors were found to be reactive by the Chediak-VDRL method.

Discussion

The Chediak and Chediak-VDRL tests were both found to be less sensitive or reactive than the VDRL slide test on a selected group of donors. Results obtained with dried blood specimens stored for varying periods of time before being tested indicate that loss of reactivity will accompany delay in testing this type of blood specimen. These two factors militate against the use of these tests on dried blood in preference to the more reactive tests for syphilis performed on heated serum.

The principal recommendations for tests for syphilis performed on dried blood are: (a) 100-percent collection of specimens may be expected even from infants since only one drop of blood is required; (b) blood may be collected by puncture of finger, toe, or heel with a minimum of apparatus; and (c) collection may be made by relatively untrained personnel. The tests must, however, be performed with standardized reagents by adequately trained laboratory personnel.

The balance of these factors favors the tests for syphilis that are performed on serum rather than on whole blood if the detection of syphilis is of paramount interest. The Chediak-type tests will, however, have a definite place under circumstances that will not allow the collection of larger quantities of blood.

The findings presented in this article are not

Table 2. Relative reactivity of Chediak, Chediak-VDRL, and quantitative VDRL slide tests on specimens from 196 patients

Test	Quantitative VDRL slide test												
	Neg- ative	4 dils or less				Over 4 dils							
		<1	1	2	4	8	16	32	64	128	256	512	Total
Chediak:													
Positive.....	1	0	3	7	8	8	13	10	4	5	0	2	61
Doubtful.....	3	2	2	6	6	7	3	7	6	3	1	1	47
Negative.....	6	5	6	6	14	16	8	7	9	6	1	4	88
Total.....	10	7	11	19	28	31	24	24	19	14	2	7	196
Chediak-VDRL:													
Reactive.....	1	2	5	9	23	30	22	23	17	12	0	5	149
Nonreactive.....	9	5	6	10	5	1	2	1	2	2	2	2	47
Total.....	10	7	11	19	28	31	24	24	19	14	2	7	196

comprehensive enough to delineate clearly the relative efficiencies of the tests examined and are presented only as a preliminary report. Further study of the Chediak tests will be the subject of a later report.

NOTE: Since this study was completed, further trials have indicated that the reactivity coverage of the Chediak-VDRL test may be expanded by using both a diluted and an undiluted antigen emulsion.

Summary

1. Results obtained with the Chediak and Chediak-VDRL tests on dried blood specimens stored for 24 and 72 hours at room temperature are presented.

2. The results of the Chediak, Chediak-VDRL, and quantitative VDRL slide tests on blood specimens from 196 donors are presented.

3. A modified Chediak test technique (Chediak-VDRL) is described.

4. Advantages and disadvantages of Chediak-type tests are discussed.

REFERENCES

- (1) Chediak, A.: El diagnostico de la sífilis practicado en una gota de sangre desecada y desfibrinada. *Arch. med. Inf.* 1: 3-14 (1932).
- (2) Dahr, P.: Die Luesdiagnose aus einem angetrockneten Tropfen Blut. *Deutsche med. Wchnschr.* 60: 94-96 (1934).
- (3) Guo, K. D.: Ein Fließpapierverfahren zur Flockungsreaktion der Syphilis. I. Mitteilung. *Deutsche med. Wchnschr.* 64: 675-677 (1938).
- (4) Vogt, H.: Untersuchungen über die Chediaksche Trockenblutreaktion und eine Abänderung der dahrschen Technik. *Med. Welt.* 12: 1802-1804 (1938).
- (5) Meinicke, E., und Fischer, R.: Die Trockenblut-MKR. II *Klin. Wchnschr.* 18: 1060-1062 (1939).
- (6) Zimmermann, E.: Die Chediak-M.K.R. II. Untersuchungen über neue Möglichkeiten. *Med. Welt.* 14: 507-508 (1940).
- (7) Chediak, A.: Simplification of the serodiagnosis of syphilis. Havana, Cuba, Ministry of National Defense, "Chediak" Institute, 1948.
- (8) Hogan, R. B., and Busch, S.: Filter paper microscopic test for syphilis, or the FPM test. A preliminary report. *J. Ven. Dis. Inform.* 31: 37-45 (1950).
- (9) Harris, Ad, and Olansky, Sidney: A study of the filter paper microscopic (FPM) test for syphilis. Preliminary report. *J. Ven. Dis. Inform.* 32: 1-4 (1951).
- (10) U. S. Public Health Service: Manual of serologic tests for syphilis. Supplement No. 22, *J. Ven. Dis. Inform.* 1947.

A Micromodification Of the VDRL Slide Test

By GEORGE R. CANNEFAX, B.S.
HAROLD R. BEYER
EDGAR B. JOHNWICK, M.D.

Except for the lack of an authoritative sensitivity and specificity evaluation, the micromodification of the VDRL slide test apparently provides a relatively simple and satisfactory method of collecting and testing small amounts of blood from infants, young children, and adults who present a problem in the collection of blood by venipuncture.

The results of testing 1,388 simultaneously collected specimens by the regular and the micro-VDRL test techniques are presented in this report. A request has been made that this modification of the VDRL slide test be included in the next National Evaluation of Serodiagnostic Tests for Syphilis.

Materials

Melting point capillary tubes (Kimble Glass Co. item 34500): Outside diameter, 1.5 to 2.0 mm.; length, 100 mm.; open at both ends. One hundred pieces are supplied in a corked glass vial. Prior to use the tubes are washed with Orvis detergent, rinsed with tap water followed by distilled water, and dried in a hot-air sterilizer. These tubes are used for the collection of blood specimens.

Glass tubing (Kimble Glass Co. item 46470): Glass tubing with an outside diameter of 4 mm., purchased in 4-foot lengths, and cut into 105-mm. lengths. The ends should be fire-polished. These tubes, when fitted with a rubber cap on each end, serve as carrying or protecting containers for the collection tubes.

Rubber caps for closing both ends of the protection tube: Micro rubber policemen as used with A. H. Thomas item 8804 or any cap that will fit 4-mm. glass tubing.

Ungraduated micropipettes: Drawn from 4-mm. outside diameter glass tubing. The pipette should have a

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length of 80 mm. and an orifice approximately 0.5 mm. in diameter.

Wax ring maker: Similar to A. H. Thomas Item 3619-A. The ring maker should be wrapped with thread to make a ring 8- to 10-mm. inside diameter when dipped in molten wax at a temperature of approximately 120° C.

Automatic micropipette (A. H. Thomas item 8212-B): The rubber bulb supplied with this instrument must be modified for use with 4-mm. glass tubing. A rubber plug, with a hole large enough to hold the glass micropipette securely, is fitted snugly into the rubber bulb of the automatic pipette.

Test tubes 50 by 6 mm.: For receiving serum.

Rubber bulb (A. H. Thomas item 8773-L): For transferring serum from collection tubes to 50- by 6-mm. test tubes.

Methods

Collection of Specimens

A finger or heel is punctured so that there is a free flow of capillary blood, more profuse than the bleeding produced by the usual puncture for blood count and hemoglobin estimations. A No. 11 Bard-Parker or similar knife blade run through a No. 3 cork stopper may be used. The point of the blade should protrude from the cork approximately one-fourth inch. The blade and stopper are inexpensive and provide a control on the depth of the incision. If the cork is quickly and firmly pressed against the skin, an adequate flow of blood will usually be obtained. The lateral surface of the finger or heel bleeds more freely than the midline palmar or plantar surface.

Although the tube is called a "capillary tube" it will not fill by capillary attraction if it is held perpendicularly. The blood is collected by holding the tube nearly horizontal to the incision. In that position the blood will flow rapidly into the tube. If the incision requires massaging to well up more blood, the end of the tube is temporarily closed, or the tube is held horizontally so that the column of blood does not move along the tube and result in an air space when more blood is collected. The presence of air spaces in the column of blood may result in insufficient serum for testing.

When the column of blood is within approximately 10 mm. of the upper end of the tube, one end is plugged by forcing it into a ¼-inch pad of nonhardening modeling clay. The other end does not require a plug. The collection

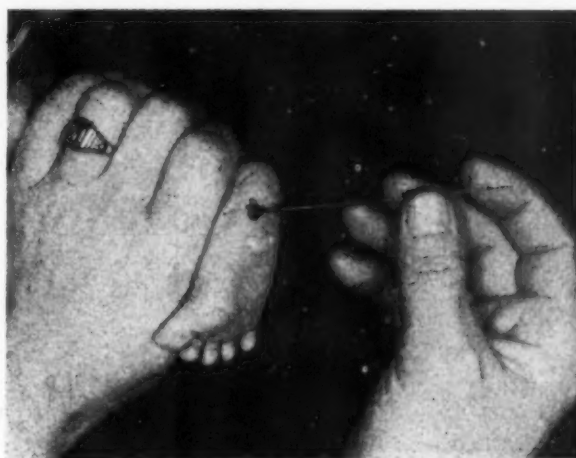


Figure 1. Collecting a specimen of blood from an infant.

tube is placed in the protecting or carrying tube and the rubber caps applied. The protecting tube, securely wrapped with a serologic test request form or other identification, is placed in a suitable mailing container and forwarded to the laboratory.

Calibration of Automatic Micropipette

The automatic pipette is calibrated to hold 0.015 ml. of serum by adjusting the knurled locking nut so that this amount is drawn into a 0.1- or 0.2-ml. pipette not more than 80 mm. in length that is calibrated to the tip. If the pipette has a diameter greater than 4 mm., it must be heated and drawn so that a constricted area, about 80 mm. from the tip of the pipette, measures approximately 4 mm. The pipette is scored with a file in the center of the constricted area, broken at that point, and the end fire-polished. The automatic pipette should be checked with this pipette each day before use to determine if 0.015 ml. is drawn into the ungraduated pipettes used for measuring serum.

Preparation of Wax Rings

Wax rings with a diameter of 8 to 10 mm., preferably nearer 8 mm., may be made of paraffin or other wax mixtures in common use. A single ring maker, not commercially available at this time, similar to A. H. Thomas item 3619-A, may be used for making the rings. The ring maker may be shaped from a paper clip bent to a diameter of 10 mm. and closed with a drop of solder. When wrapped with thread and dipped in paraffin at a temperature

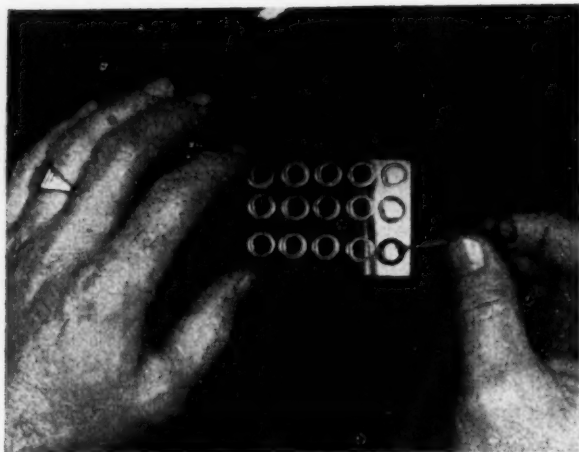


Figure 2. Making wax rings for the micro-VDRL test.

of 120° C., the paper-clip ring maker will produce rings with an internal diameter of approximately 8 mm.

Preparation of Specimen for Testing

When the blood is received in the laboratory, the request slip accompanying the specimen is numbered and the melting-point tube is placed in a 100- by 13-mm. test tube similarly numbered. Before centrifuging, the clot is freed from the side of the melting-point tube by means of a wire stylet such as those supplied with 19-gauge hypodermic needles, or by a similar small wire. The specimen is centrifuged in the numbered test tube for 15 minutes at about one-half the revolutions per minute used with venous specimens. Inactivation is accomplished by placing the melting-point tube in a numbered 100- by 13-mm. test tube which is filled with water at 56° C. This tube has a small amount of cotton in the bottom sufficient to raise the end of the melting-point tube above the lip of the water-filled test tube. The inactivation temperature is maintained by placing the water-filled test tube in a serologic water bath commonly used for inactivation. After inactivation the melting-point tube is placed in the numbered test tube that was used to hold the specimen during centrifugation.

A small rubber bulb similar to that used with tubes of smallpox vaccine is placed over the serum end of the melting-point tube and an ampule file is used to score the tube just above the level of the clot. The tube, held horizontally, is broken at that point and the serum is

forced by means of the rubber bulb into a 50-by 6-mm. test tube, which is numbered with a wax pencil and/or placed in a wooden block with numbered holes.

Qualitative Testing

Serum is measured into the center of a wax ring by means of the automatic pipette and the ungraduated glass micropipette. The slide on the actuating arm of the automatic pipette is placed in the lower position. (The arm is actuated and the slide moved up and down with the thumb.) The tip of the glass pipette is placed in the serum and the arm depressed to force out serum that may have entered the glass tip by capillary attraction, the arm released, and the serum drawn into the glass pipette. The serum is discharged from the pipette into the center of a wax ring by raising the slide and depressing the arm. VDRL slide test (1) antigen is dropped onto the serum by means of a 25-gauge hypodermic needle attached to a 2-ml. syringe. The needle and syringe must be held vertically and deliver approximately 180 drops per milliliter. The serum-antigen mixture is rotated, read, and reported as described in the VDRL slide test procedure.

Quantitative Testing

Using an automatic pipette, 0.015 ml. of 0.9-percent sodium chloride solution is placed in each of 10 wax rings. Serum is drawn into the glass pipette attached to the automatic pipette as in qualitative testing. The slide of the automatic pipette is raised to the upper position and the 0.015 ml. of serum expelled into the first ring. With the slide held in the upper position the arm is repeatedly depressed and released (at least three times) so that the serum and saline are drawn into and forced out of the glass pipette to insure thorough mixing. When the mixture is expelled the last time, the slide is allowed to fall into the lower position. The tip of the glass pipette is placed in the serum dilution; the arm is depressed to force out any fluid that may have been drawn into the tip by capillary attraction, and released. The serum dilution thus obtained in the glass pipette is transferred to the second ring containing saline, and mixing manipulation is repeated. VDRL slide test antigen is added to each serum dilu-

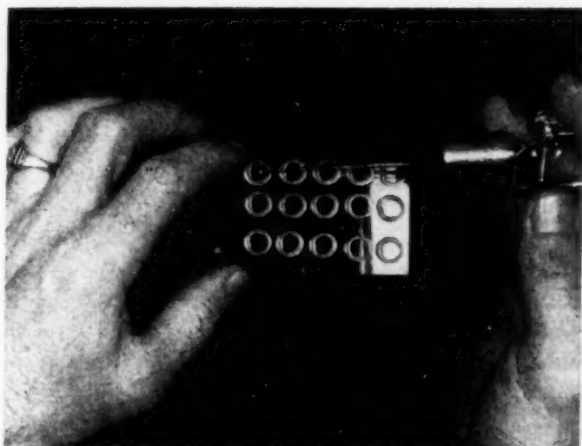


Figure 3. Placing 0.015 ml. of serum in wax rings.

tion as described for qualitative testing. The serum dilutions are rotated, read, and reported as described in the VDRL slide test procedure.

Results

Qualitative Testing

The results of qualitative testing, in which 1,388 specimens were tested with the regular and micro-VDRL procedures, are shown in table 1. In this series the micro procedure was 1.8 percent more positive than the regular VDRL test when positive results were considered. When positive and weakly positive results were combined the micro procedure was 1.7 percent more positive. These differences in sensitivity are not statistically significant.

Table 2 is a presentation of comparative results of the two tests with respect to agreement or disagreement. The number of specimens found to be positive by both the VDRL slide and micro-VDRL slide tests is 641. Similarly, 510 specimens are identified by both tests as being negative. The total agreement between the two tests on the same specimens is 84.08

percent. However, if only two classifications of test results are used (positive-weakly positive and negative-rough negative) the total agreement of the two tests is 91.28 percent.

Quantitative Testing

Results of quantitative testing with 238 specimens are shown in table 3. It will be seen that 217, or 91.2 percent, of the entire series did not vary by more than one dilution between the regular and micro-VDRL slide tests. These variations and those of greater magnitude probably are due to technical errors. It is assumed that variations of this type will decrease as technical skill with small quantities increases.

Field Collection of Specimens

Field collectors were supplied with materials for collection of blood and were advised to procure specimens for the micro test in all instances in which venipuncture had failed or did not appear feasible. These workers received a demonstration of the collecting technique but were otherwise inexperienced in this type of specimen collection. Specimens of blood for the micro test were collected by the Arkansas State Board of Health in 1,451 cases in which venipuncture was not feasible, and the specimens forwarded to the Medical Center for testing.

Of these specimens 1,334 (91.9 percent), were satisfactory for qualitative testing. One hundred and seventeen (8.1 percent) were unsatisfactory for testing because of (1) insufficient quantity (93, 6.4 percent), (2) hemolysis (15, 1 percent), and (3) broken collection tubes (9, 0.6 percent). The results of the 1,334 specimens that were tested with the micro-VDRL test are as follows: 154 (10.6 percent) specimens were found to be positive; 1,180 (81.3 percent) specimens, negative.

Table 1. Results of 1,388 qualitative tests. VDRL slide test and micro-VDRL slide test

Test procedure	Positive		Weakly positive		Rough negative		Negative	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
VDRL slide test.....	692	49.9	65	4.7	60	4.3	571	41.1
Micro-VDRL slide test.....	717	51.7	63	4.5	45	3.2	563	40.6

Table 2. Comparative testing (regular and micro-VDRL slide tests) of 1,388 simultaneously obtained specimens

Micro-VDRL slide test results	VDRL slide test results				
	Positive	Weakly positive	Rough negative	Negative	Total
Positive.....	641	34	16	26	717
Weakly positive...	25	8	10	20	63
Rough negative...	13	9	8	15	45
Negative.....	13	14	26	510	563
Total.....	692	65	60	571	1,388

Table 3. Results of 236 quantitative tests: micro-VDRL slide test and VDRL slide test

Micro-VDRL more positive				Both techniques same titer	VDRL more positive			
Difference in titer ¹					Difference in titer ¹			
4	3	2	1	----- 96	1	2	3	4
2	2	2	32		89	15	0	0

¹ Expressed as an increase in terms of serial dilutions.

Approximately one-third of the specimens which had quantities insufficient for testing came from the group of patients under 3 years of age. Thirty-eight of the positive specimens did not have sufficient serum for quantitation, and 181 of the negative specimens would have lacked sufficient specimen material if quantitation had been required.

Age was reported on the request form for 1,115 of the patients from whom blood specimens were collected in the field. Of these 1,115 patients, 167 (15 percent) were less than 1 year old; 189 (17.0 percent) were between 1 and 3 years; 287 (25.7 percent) were between 3 and 10 years; and 472 (42.3 percent) were between 10 and 60 years of age.

Summary

The micromodification of the VDRL slide test permits qualitative and quantitative testing with a specimen of 0.1 to 0.15 ml. (2 to 3 drops) of capillary blood.

The qualitative and quantitative modifications of the VDRL slide test herein described

consist of the performance of that test with one-third amounts of serum, antigen, and surface area.

Specimen material is obtained by finger, toe, or heel puncture and collection in "capillary" glass tubes.

An automatic pipette, fitted with an inexpensive ungraduated glass pipette, is employed for serum measurement. Calibration of the automatic pipette and fabrication of the ungraduated glass pipettes are described.

It was found that 6.4 percent of all the specimens received were of insufficient quantity for qualitative testing. The collection of specimens in "capillary" glass tubes would be greatly facilitated if an automatic lancet with a thin blade 4 mm. wide set to protrude 2 mm. were available. Such a lancet has been fashioned from the conventional type, and its use at the medical center has resulted in 100-percent collection of sufficient specimen material.

Sensitivity and specificity ratings have not been determined for this modification of the VDRL slide test. However, since the series of tests reported here showed the micro procedure to yield 1.8 percent more positive results, it may be assumed, for the present, that the procedure may be a little more sensitive. It does not appear probable that this percentage increase in test sensitivity is sufficient to reduce the specificity of this modification below acceptable limits since the difference as shown with these data is not statistically significant.

Quantitative testing is accomplished by preparing serum dilutions within the wax rings of the slide in place of test tubes. Comparative quantitative testing of the micro technique and the regular VDRL slide test has shown 91.2 percent of the tests to vary by no more than one dilution. It is assumed that variations greater than one dilution have been due to faulty technique and that the incidence and magnitude of variations will decrease as experience with the test procedure increases.

Most of the patients from whom specimens were obtained in the field probably would not have had the benefit of a serologic test for syphilis if this new collecting technique had not been available to the field worker. As previously indicated, analysis of 1,115 patients for whom age was reported showed that 32 percent

of the patients were less than 3 years of age, 57.7 percent were under age 10, and 42.3 percent over age 10.

REFERENCE

- (1) U. S. Public Health Service: Manual of serologic tests for syphilis. Supplement No. 22, to J. Ven. Dis. Inform., 1949, pp. 109-119.

A Statistical Evaluation Of the FPM Test

By AD HARRIS
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HENRY MILLER, B.S.

A further evaluation of the efficiency of the filter paper microscopic (FPM) test (1) as a "detector" test for syphilitic infection, based on specimens from 276 donors, including the specimens from the 266 donors analyzed in the preliminary report (2) is presented in this paper. As noted in that report, collection and distribution of blood specimens were carried out by the Eastern Medical Center, Durham, N. C., and by the staff of the Venereal Disease Research Laboratory at the Alto Medical Center, Alto, Ga.

Each Tuesday, blood specimens from 10 to 30 donors were collected and five filter paper strips and five tubes of whole blood were prepared from each specimen. One filter paper strip and one tube of whole blood from each donor were sent to each of the following laboratories: Dr. Kahn, Dr. Kline, Mr. Mazzini, the Eastern Medical Center, and the Venereal Disease Research Laboratory. On the following Friday each laboratory performed the FPM test on the filter paper in accordance with the test protocol and,

in addition, any modification of the FPM test that they might devise. The tube of whole blood was used to perform tests commonly used in the various laboratories, hereafter referred to as standard tests. Antigen used for the FPM and VDRL tests, if performed, was distributed by the Venereal Disease Research Laboratory.

At the time of collection and distribution of specimens, the Eastern Medical Center and the Alto Medical Center established a diagnosis by clinical and serologic findings of all donors from whom the specimens for this study were taken.

For purposes of evaluation, two methods of comparison of the FPM test are presented. The first method discussed is that of comparing the test results of each participating laboratory with established diagnostic results. The second method disregards diagnostic findings and compares the results of the FPM test findings in a particular laboratory with the other tests performed in that laboratory. The second method of evaluation has been used for the following reasons: (a) A diagnosis by clinical means is not always obtainable in actual practice; (b) an error in diagnosis is possible. Certain specimens collected from donors diagnosed as positive or doubtful have been found to be negative by the standard tests. The agreement by all tests in a laboratory as to the negativity of these particular (diagnosed positive) specimens ranges from 2 specimens in the Venereal Disease Research Laboratory to 18 specimens in the Kahn laboratory. This type of disagreement (diagnosed positive, tested negative) may be due to laboratory technique or to an error in diagnosis. In either case a comparison of tests within laboratories seems justifiable.

In both methods, comparison of specimens as to agreement or disagreement is made only when tests have been performed. Tests giving doubtful reactions are considered positive, since it is not the purpose of this study to analyze the quantitative results produced by the FPM test.

Method 1

The various diagnoses of syphilis, based on clinical and serologic findings, established by the Eastern and Alto Medical Centers have been classified as follows:

Mr. Harris is a serologist and the assistant director of the Venereal Disease Research Laboratory; Dr. Olansky is the director; Mr. Miller is a statistician in the Division of Venereal Disease, Public Health Service.

1. Positive—secondary; early latent; late latent; asymptomatic central nervous system (CNS); symptomatic CNS (paresis, tabes, etc); cardiovascular; CNS plus cardiovascular syphilis (CVS); congenital; serorelapse; infectious relapse.

2. Negative—normal; other venereal diseases, not syphilis.

Since clinical manifestations were not considered by the testing laboratories in determining results, and negative blood tests are highly probable in patients with primary syphilis, the following diagnoses of the centers were eliminated from comparison: (a) primary; (b) reinfection regardless of stage of syphilis; and (c) suspect only or late syphilis.

Table 1 shows the percent of agreement and disagreement of the serologic test results obtained in each of the five testing laboratories as compared with the diagnoses of the Alto and Eastern Medical Centers. Tables giving the serologic test results as compared with the diagnoses made in these laboratories may be obtained from the authors upon request.

Eight different tests were performed in the Kline laboratory, three of which were modifications of the FPM test. Of 231 specimens used for comparison between the FPM test and the diagnosis, 161 were found to be positive and 13 negative by both the FPM test and the diagnosis. The percent of agreement is 75.3 percent. Fifty-six specimens were considered positive by the diagnoses, negative by the FPM test. The rate of disagreement is 24.7 percent. The FPM test modifications agree rather closely with those of the FPM test. The highest agreement found between the FPM test or any of its modifications is 81.8 percent for the FPM modification test. The difference between this rate of agreement and the lowest rate of agreement between the diagnosis and a standard test (88.7 percent for the Kline diagnostic) is statistically significant at the 5-percent level. This difference may be attributed to the inability of the FPM test and its modifications to identify specimens diagnosed as positive.

In the Venereal Disease Research Laboratory, the FPM test agreed with the diagnosis on 168

Table 1. Percent agreement and disagreement of serologic test results of five laboratories with the established diagnostic results¹

Serologic test	Kline laboratory		Venereal Disease Research Laboratory		Eastern Medical Center		Mazzini laboratory		Kahn laboratory	
	Relation to diagnosis		Relation to diagnosis		Relation to diagnosis		Relation to diagnosis		Relation to diagnosis	
	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement
FPM	75.3	24.7	72.7	27.3	71.2	28.8	91.3	8.7	77.9	22.1
FPM Dri-Rite					77.3	22.7				
FPM Mazzini cardiolipin							93.5	6.5		
FPM modification	81.8	18.2								
FPM modification standard	81.4	18.6								
FPM standard	74.9	25.1								
Kahn presumptive									90.2	9.8
Kahn standard			91.4	8.6	90.0	10.0			88.3	11.7
Kline diagnostic	88.7	11.3								
Kline exclusion	94.8	5.2								
Kline standard	95.7	4.3	97.2	2.8						
Kolmer simplified			91.0	9.0	87.7	12.3				
Mazzini cardiolipin							96.9	3.1		
Mazzini flocculation			94.4	5.6						
Rein-Bossak			96.3	3.7						
VDRL slide	92.6	7.4	93.9	6.1	89.1	10.9	96.1	3.9		

¹ Based on clinical and serologic findings at Eastern and Alto Medical Centers.

NOTE.—More detailed data may be obtained from authors.

of the 231 specimens used for comparison, a rate of agreement of 72.7 percent. With the exception of one comparison, disagreement between FPM and diagnostic results was due to 62 specimens diagnosed positive but negative by the FPM test. The highest degree of agreement in this laboratory is 97.2 percent and is found under the results of the Kline standard test. Only 2.8 percent were found to be in disagreement. All differences in the rate of agreement between the FPM test and the standard tests are significant beyond the 5-percent level, again showing the difference in the ability of the FPM and the standard tests to recognize positive diagnosed specimens.

The results of tests in the Eastern Medical Center laboratory and the Kahn laboratory are in accord with results in the laboratories already discussed. However, special attention is called to the comparison of diagnostic results and results of tests performed in the Mazzini laboratory. The rate of agreement between diagnostic results and the FPM test and a modification, the FPM-Mazzini-cardiolipin test (2) using the Mazzini antigen instead of the VDRL antigen, is approximately 20 percent greater than any other FPM test or FPM test modifications found in the other participating laboratories. The percent of agreement in the FPM test as compared to the agreement in the VDRL slide and the Mazzini-cardiolipin tests is significantly different at the 5-percent level. However, there is no significant difference between the FPM-Mazzini-cardiolipin test and the VDRL slide and Mazzini-cardiolipin tests. This high degree of agreement between diagnostic results and the FPM and FPM-Mazzini-cardiolipin test results was also noted in the previous report (2). In answer to an inquiry by the authors of that article, Mr. Mazzini reported that the FPM test performed in his laboratory was being carried out in accordance with the testing procedure.

Under this first method of comparison, the laboratory results of the FPM test and the standard tests have shown a significant difference in agreement with the diagnoses. Although a few specimens diagnosed as negative are positive by the FPM test, the greatest difference may be attributed to the inability of the

FPM test to identify specimens from donors in positive diagnostic categories.

Method 2

Results of method 2 are presented in table 2. By this procedure the results of the FPM test are compared with respect to agreement or disagreement with the various tests performed within each laboratory. To determine what variation could be expected within a laboratory, two standard testing methods whose efficiency is generally known are compared and will be referred to as control groups. Data from these groups are presented in table 3.

In the Kline laboratory, the results of comparison of tests by this method show a high degree of agreement between the FPM test and its modifications. This may be due to the similarity of reactivity between these tests. The FPM-FPM standard comparison reveals almost perfect agreement—99.6 percent. However, the agreement between the FPM test and the standard tests in this laboratory is quite low. The greatest amount of agreement in these comparisons is 84.2 percent in the FPM-Kline diagnostic comparison. The lowest agreement (78.0 percent) exists in the FPM-Kline standard and the FPM-Kline exclusion comparisons, and is attributable in each case to 60 specimens diagnosed negative by the FPM test but positive by the two Kline tests.

The tests used as a control group for this laboratory (VDRL slide-Kline standard) show an evident similarity, with an agreement rate of 96.3 percent (table 3). While perfect agreement cannot be expected, this does indicate rather definitely that the low rate of agreement between the FPM-VDRL slide and the FPM-Kline standard tests is not due to the fact that the VDRL slide and Kline tests lack specificity, but rather that the FPM test is inefficient in the identification of positive serologic specimens.

In the Venereal Disease Research Laboratory, no modifications of the FPM test were performed but, as in the Kline laboratory, the rate of agreement between the FPM test and the standard tests is rather low, lower than one might expect if these tests are comparable. The greatest amount of disagreement occurs in the

Table 2. Percent agreement and disagreement of blood specimen results obtained by the FPM test¹ and by other tests performed in five laboratories

Serologic test	Kline laboratory		Venereal Disease Research Laboratory		Eastern Medical Center		Mazzini laboratory		Kahn laboratory	
	Relation to FPM test		Relation to FPM test		Relation to FPM test		Relation to FPM test		Relation to FPM test	
	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement	Agreement	Disagreement
FPM Dri-Rite					93.3	6.7				
FPM-Mazzini-cardiolipin							96.3	3.7		
FPM modification	93.1	6.9								
FPM modification standard	93.4	6.6								
FPM standard	99.6	0.4								
Kahn presumptive									85.0	15.0
Kahn standard			79.2	20.8	78.3	21.7			88.2	11.8
Kline diagnostic	84.2	15.8								
Kline exclusion	78.0	22.0								
Kline standard	78.0	22.0	72.6	27.4						
Kolmer simplified			79.8	20.2	79.1	20.9				
Mazzini-cardiolipin							92.6	7.4		
Mazzini flocculation			74.1	25.9						
Rein-Bossak			74.7	25.3						
VDRL slide	81.0	19.0	77.6	22.4	79.8	20.2	93.3	6.7		

¹ As performed in accordance with the test protocol.

NOTE. More detailed data may be obtained from authors.

FPM-Kline standard comparison, indicating that the agreement between the two tests was 72.6 percent; disagreement, 27.4 percent. Disagreement is due to 71 specimens indicated positive by the Kline test and negative by the FPM test. The control group (Kahn standard-Kline standard) indicates quite a difference in agreement in contrast to the FPM comparisons. Here the total agreement is 93.3 percent. Statistical tests carried out between the FPM-Kahn standard and the FPM-Kline standard comparisons showed no statistical difference. However, the difference between the Kahn standard-Kline standard comparison and the other two comparisons mentioned is highly significant, due to

the large number of positive specimens called negative by the FPM test.

At the Eastern Medical Center laboratory, the control group of Kahn standard and Kolmer simplified tests shows a total agreement of 95.2 percent, whereas the highest agreement between the FPM test and any standard test performed in this laboratory is only 79.8 percent (VDRL slide test). The FPM Dri-Rite test indicated 93.3-percent agreement with the FPM test. For further evidence of reactivity of a modification of the FPM test, the FPM Dri-Rite test and the Kahn test were compared and an agreement of 83.0 percent was found. This was not significantly different from the results

Table 3. Percent agreement and disagreement of control groups within laboratories

Laboratory	Control groups	Percent agreement	Percent disagreement
Kline	VDRL slide v. Kline standard	96.3	3.7
Venereal Disease Research Laboratory	Kahn standard v. Kline standard	93.3	6.7
Eastern Medical Center	Kahn standard v. Kolmer simplified	95.2	4.8
Mazzini	VDRL slide v. Mazzini-cardiolipin	99.3	.7
Kahn	Kahn standard v. Kahn presumptive	97.0	3.0

of comparisons of the FPM test with the other standard tests in this laboratory, indicating the similarity of the two FPM tests in their inability to agree with other tests in identifying positive specimens.

The results at the Mazzini laboratory show a higher percentage of agreement between the FPM test and standard tests than was obtained by any of the other laboratories. The agreement of FPM results with the diagnoses established by the medical centers was also much higher in this laboratory than in the other testing laboratories. However, the control group of VDRL slide-Mazzini-cardiolipin tests is also in high agreement (99.3 percent) which is significantly different (5-percent level) from the FPM-VDRL slide (93.3 percent) and the FPM-Mazzini-cardiolipin comparison (92.6 percent), again indicating the lack of reactivity in the FPM test (table 3).

The comparison of results from the Kahn laboratory shows somewhat higher agreements between standard tests (with the exception of the Mazzini laboratory) than those obtained in the other three laboratories. However, the conclusion reached from results obtained by all reporting laboratories appears to be the same—the failure of the FPM test to identify positive specimens. The degree of agreement between the control groups can be seen in table 3. These five groups of tests have an average agreement of 96.3 percent compared to 81.0 percent between the FPM and standard tests.

Since the FPM test is less reactive than the commonly employed laboratory tests, it would be less efficient as a "detector" test for field survey use. However, as stated in the previous report (2), this fact should not militate against the use of the FPM test under conditions in which another type of blood collection cannot be used.

Summary

1. Filter paper strips and tubes of whole blood from 276 donors were distributed to 5 laboratories.

2. Each laboratory performed the FPM test in accordance with the testing protocol and any modification of the FPM test if they so desired. The tube of whole blood was used to

perform other testing procedures employed in the laboratories.

3. Two methods of analysis are presented. Both methods show that a significant difference (5-percent level) exists between the ability of commonly employed laboratory tests and the FPM test to identify positive and doubtful serologic specimens.

REFERENCES

- (1) Hogan, Ralph B., and Busch, Shirley: Filter paper microscopic test for syphilis, or the FPM-test. A preliminary report. *J. Ven. Dis. Inform.* 31: 37-45 (1950).
- (2) Harris, A., and Olansky, Sidney: A study of the filter paper microscopic (FPM) test for syphilis. Preliminary report. *J. Ven. Dis. Inform.* 32: 1-4 (1951).

Use of the FPM Test In a Control Program

By CHARLES R. FREEBLE, Jr., M.D.
BERTINA ORSBURN, B.S.

When the filter paper microscopic (FPM) test for syphilis was reported by Hogan and Busch (1), it appeared to present a simple method of collecting, shipping, and testing blood. This method seemed especially desirable in screening children for congenital syphilis, since it obviated the necessity for jugular punctures. In Ohio, the test has been studied from the standpoint of ease of use under field conditions and by comparison with the standard serologic tests currently being performed by the Ohio Department of Health.

Use in Mass Testing Programs

The FPM technique is suitable for use in mass testing programs. Although more time is required to obtain a specimen of blood for the

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FPM test than for venipuncture, the preliminary preparation time for the FPM test is much less. The supplies necessary to carry out a testing program with the FPM test are minimal, and the specimens are easily handled and transported. It is not difficult to train a person to obtain a specimen for the FPM test, although experience obtained under supervision is necessary to insure suitable specimens.

During a mass blood testing and chest X-ray program in a northeastern Ohio county having a low syphilis incidence, blood specimens for the FPM test were collected from 902 persons of all ages. Three tests were positive. Results of serologic tests on blood samples obtained from these three persons by venipuncture, together with the histories and findings on physical examination, indicated that they were suffering from previously undiscovered latent syphilis.

After completion of the mass survey, two local health department nurses obtained 187 specimens for the FPM test from children in households which they visited in the ordinary course of their duties. They were enthusiastic about the procedure as a suitable method of obtaining blood specimens in the home. They pointed out that it would eliminate numerous nursing visits and the problem of arranging for attendance at clinics, in addition to overcoming parents' reluctance to permit jugular punctures on infants and small children.

Usually, little or no objection is offered to obtaining a blood specimen by finger puncture. Parents volunteer for the test and urge their children to submit to it. As many persons volunteered for the FPM test as for the chest X-ray. Of the 902 persons tested, 86 (9.5 per cent) were under 10 years of age.



Figure 1. Collecting blood for the FPM test from a child in his home.

Comparison With Standard Tests

Following exploration of the suitability of the FPM test for field use, a comparison was made of results of this test and results of standard Kahn, Kline, and Kolmer tests performed as a daily routine at the Ohio Department of Health laboratory. Specimens of blood in 8-cc. amounts were obtained by venipuncture from 897 persons admitted to the Central Ohio Rapid Treatment Center. Filter paper strips were saturated by dipping them into the tubes of blood. They were then drained and allowed to dry and the FPM test was performed by the method of Hogan and Busch (1). The tubes of blood were forwarded to the laboratory of the Ohio Department of Health for serologic testing.

A comparison of the results of the FPM test with each of the other tests is presented in table 1. Based on the figures in table 1, the percentages of agreement between the FPM and

Table 1. FPM test results compared to results of Kahn, Kline, and Kolmer tests on specimens from 897 patients at Central Ohio Rapid Treatment Center

FPM	Kahn		Kline		Kolmer	
	Positive and doubtful	Negative	Positive and doubtful	Negative	Positive and doubtful	Negative
Positive and doubtful.....	686	41	726	1	714	13
Negative.....	51	119	106	64	87	83

Table 2. Diagnostic classification of 110 individuals whose blood specimens were negative with the FPM test but positive with 2 or more of the standard tests

Diagnosis	Previously treated	Not previously treated	Total
Primary-secondary	1	2	3
Early latent	22	11	33
Late latent	25	6	31
Asymptomatic central nervous system	15	4	19
Tabes dorsalis	6	0	6
Paresis	2	0	2
Early congenital	0	1	1
Late congenital	5	3	8
No venereal disease	0	7	7
Total	76	34	110

Kahn, Kline, and Kolmer tests were 89.7, 88.1, and 88.9, respectively; disagreement, 10.3, 11.9, and 11.1. The percentage of agreement indicates the number of instances in which both the FPM test and the standard tests gave positive or doubtful results, plus the instances in which both gave negative results. "Disagreement" means the number of times varying results were obtained by the two tests. Most of the disagreement between the FPM and Kline tests and the FPM and Kolmer tests is due to the large number of specimens that were positive by the standard tests and negative by the FPM test. While this discrepancy is also noted in the FPM-Kahn tests comparison, it accounts for a much smaller part of the disagreement.

Table 3. Results of quantitative Kahn test on 51 specimens negative to the FPM test

Kahn units	Number of specimens negative to FPM test
1	20
2	11
3	11
4	4
10	1
20	
40	2
80	1
160	1
Total	51

Of the 897 specimens tested, 110 were negative to the FPM test and positive to two or more of the serologic tests. The diagnoses of these 110 individuals are presented in table 2. Of 34 patients with untreated syphilis in all stages, blood tests of 27 were negative to the FPM test, but positive to two or more of the other tests. Results in Kahn titers on 51 specimens negative to the FPM test but positive to the Kahn test are shown in table 3.



Figure 2. Collecting blood for FPM test in a clinic.

Discussion

The FPM test offers a simple method for the collection of blood specimens, and, under field conditions, the test has definite advantages: (a) greater willingness of individuals to submit to and to allow their children to submit to finger punctures; (b) ease of obtaining specimens by nurses and other personnel after a minimum of instruction; and (c) saving of clinic and nursing time, since the test can be made at home. Little time is saved in mass testing programs, but the avoidance of time lost in handling supplies and equipment for venipuncture more than compensates for the time required to obtain blood for the FPM test.

However, the obviously lower reactivity of the FPM test mitigates its usefulness as a screening test. FPM, Kline, Kahn, and Kolmer tests on a series of patients at the Central Ohio Rapid Treatment Center yielded many more negative reactions with the FPM test than with the standard serologic test (table 1). Tests on

110 serums were reported negative to the FPM test and positive to at least two of the other tests (table 2). In a screening procedure with the FPM test these seropositive persons probably would have been missed. Despite its advantages in collecting, the lower sensitivity of the FPM test makes it of questionable value in obtaining reliable evaluation tests on children. These observations on reactivity are consistent with the previously reported findings of Harris and Olansky (2).

Summary

1. Results of field use of the FPM test in a demonstration screening of 902 individuals in an Ohio county and in obtaining 187 specimens from children during routine public health nursing visits to homes are reported. The filter paper method of blood collection has definite advantages, as it is suited to mass as well as home use, and professional personnel can be quickly trained to get satisfactory specimens.

2. Comparative studies of the FPM and standard tests in routine use in Ohio performed on 897 patients at the Central Ohio Rapid Treatment Center are reported. The lower reactivity of the FPM test by comparison with the other tests negates the definite advantages of ease of specimen collection, and limits the use of the test to instances in which no other method of obtaining a specimen is possible. False security which might result from a negative report by the FPM test renders the advisability of the test's limited use doubtful.

REFERENCES

- (1) Hogan, Ralph B., and Busch, Shirley: Filter paper microscopic test for syphilis, or the FPM test. A preliminary report. *J. Ven. Dis. Inform.* 31: 37-45 (1950).
- (2) Harris, Ad, and Olansky, Sidney: A study of the filter paper microscopic (FPM) test for syphilis. Preliminary report. *J. Ven. Dis. Inform.* 32: 1-4 (1951).

Tularemia From a Wood Rat in New Mexico

By DEAN H. ECKE, M.S., and ROBERT HOLDENRIED, Ph.D.

Tissue from a wood rat (*Neotoma albigula*) found dead at Gran Quivira National Monument, N. Mex., April 12, 1951, was shown in the laboratory to be infected with *Pasteurella tularensis* (McCoy and Chapin). This is the first time that *N. albigula* has been found nat-

urally infected with tularemia. Tularemia in a Pacific Coast species (*Neotoma fuscipes*), however, has been previously reported (1).

The superintendent of the Gran Quivira National Monument had observed dead cottontails (*Sylvilagus auduboni*) in the area during the previous 8 months. At his request a survey was conducted to determine the cause of the epizootic. Field-collected material was obtained by the plague survey crew of the New Mexico Department of Public Health. The crew cooperated with the Public Health Service's Western Communicable Disease Laboratory, San Francisco, Calif., which conducted the laboratory tests. The findings of this survey are recorded in the table.

Mr. Ecke is with the Communicable Disease Center of the Public Health Service, assigned as assistant sanitarian to the Thomasville Field Station, Thomasville, Ga. Dr. Holdenried, scientist, is also with the Communicable Disease Center and is assigned to the Santa Fe Field Station, Santa Fe, N. Mex.

Results of survey of mammals at Gran Quivira National Monument, April 10-13, 1951

Mammal species	Number mammals	Ticks			Fleas			Number with positive tissue ²
		Number	Average number per animal ¹	Number positive pools ²	Number	Average number per animal ¹	Number positive pools ²	
<i>Sylvilagus auduboni</i> -----	17	101	6	2	100	6	0	2
<i>Neotoma albigula</i> -----	42	0	0	0	130	3	0	1
<i>Peromyscus truei</i> -----	19	0	0	0	29	2	0	0
<i>Peromyscus maniculatus</i> ----	20	0	0	0	11	1	0	0
<i>Dipodomys ordii</i> -----	27	5	1	0	2	0	0	0
<i>Dipodomys spectabilis</i> -----	5	0	0	0	7	1	0	0
<i>Reithrodontomys megalotis</i> ----	1	0	0	0	1	1	0	0
<i>Citellus variegatus</i> -----	1	0	0	0	6	6	0	0
Total-----	132	106	-----	2	286	-----	0	3

¹ Averages rounded out to nearest whole number.

² Positive for *P. tularensis*.

Ticks were numerous on cottontails in the area but were found, in small numbers, on only one species of rodent (*Dipodomys ordii*). Two pools of ticks from cottontails contained tularemia organisms. Fleas were found on all of the mammals captured. None of the flea pools were found to be infected even though taken from cottontails shown to have infected tissue or to be carrying infected ticks.

These observations suggest that the epizootic was primarily limited to the cottontail population, with the wood rat involved secondarily. In this area of New Mexico, wood rats and cottontails are frequently found in close association, often sharing the same living quarters. As a result, it is likely that the opportunity occasionally arises for a limited exchange of ectoparasites, and that the wood rat became in-

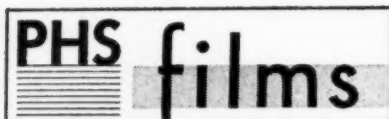
fectured with tularemia from ticks which had previously fed on an infected rabbit. The long period over which dead cottontails were observed and the large number of live animals remaining at the time of the survey indicate that the epizootic was not of a fulminating, rapidly spreading nature.

It is concluded that tularemia in the wood rat was a chance infection and that wood rats in this locality are not important in the ecology of tularemia.

REFERENCE

- (1) Burroughs, A. L., Holdenried, R., Longanecker, D. S., and Meyer, K. F.: A field study of latent tularemia in rodents with a list of all known naturally infected vertebrates. *J. Infect. Dis.* 76: 115-119 (1945).





A Drop in the Bucket

16 mm., sound, color, 13 minutes, 1951.
Audience: General public.

Available: Loan—State and local health departments; regional offices, Federal Security Agency. Purchase—United World Films, Inc., 1445 Park Avenue, New York 29, N. Y.

"A Drop in the Bucket" was produced for the Division of Dental Public Health of the Public Health Service by Warner-Pathe News, Inc.

This film tells the story of how one community brought the benefits of fluoridated water to its children—how the dentists, the health officers, the mayor, the water works engineer, and citizens got together and fought for fluoridation before it was a widely recognized public health measure.

Based in part on the story of how the people of Newark, Del., added fluoride to their water supply, the film portrays the down-to-earth situations that exist in every community—the typical conflicts, the doubts about fluoridation, and the



evidence to support its use. The film answers many questions parents ask: What good does fluoridation do? How much does it cost? What is fluoride? What does it look like? How do you add it to water? The film shows that fluoride in a water supply is not dangerous—it does not stain teeth nor make bones brittle. It does not harden water nor color it. Neither does it give any taste to water.

New Film Catalogs

USPHS Motion Pictures, A Selected List, includes 42 films which the Public Health Service has either produced or assisted in producing and which are considered currently useful. Essential data, a brief description of the content of the film, and the manner in which it can be obtained are given for each listing. This catalog does not include films produced by the Communicable Disease Center which are contained in the CDC Catalog of Motion Pictures and Filmstrips for Professional and Subprofessional Audiences. (A limited number of these are available from the Communicable Disease Center, Atlanta, Ga.)

In addition to films of general interest, subject areas covered by USPHS Motion Pictures are: cancer, dental health, diabetes, mental health, occupational health, rheumatic heart disease, small-milk-plant operation, tuberculosis, venereal disease, water pollution, excess weight, first aid, and rodent control.

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USPHS Motion Pictures, A Selected List. 1952. 13 pages. Mimeo-

graphed. Available without charge from Public Inquiries Branch, Public Health Service, Washington 25, D. C.

Motion Pictures on Child Life, compiled by the Children's Bureau, is a list of more than 450 16-mm. films available from all sources on various aspects of child life and development. Most of the films are for adults. A few are for children although they are not planned for classroom use. As in the case of the Public Health Service listings, essential data, a brief description of the content of the film, and the manner in which it may be obtained are given for each. No attempt has been made to evaluate the films.

The following areas of the health field are covered in this catalog: health services, personal health and posture, prevention and treatment of disease, dental hygiene, handicapped children, mental health, and nutrition.

Areas of child life and development covered by the remaining listings are: adolescence, child care, child development, children in foreign countries, community life, juvenile delinquency, maternity care, recreation and play, safety, sex education, and welfare services. Supplements to the catalog will be issued from time to time.

• • •

Motion Pictures on Child Life. A list of 16-mm. films. Published by the Children's Bureau of the Social Security Administration, Federal Security Agency. 1952. 61 pages. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. 40 cents.

Scheduled for Early Publication

Activities of Health Officers in Local Health Departments. By Marion Ferguson, Harald M. Graning and Bess A. Cheney
Public Health Considerations in Industrial Dentistry. Four briefs from a symposium presented at the recent Industrial Health Conference in Cincinnati.

Health Manpower in the U. S.

Health manpower is a matter of increasing concern to the United States as a whole and for many States and communities. Forthcoming tabulations of the 1950 Census of Population will provide detailed information as to the actual current situation. Meantime, a summary of data now available may be useful. Such a summary is presented here and is based on counts and estimates prepared by the medical and health professional associations.

Physicians

The latest available information for 1950 estimates a total of 209,040 physicians (table). For 1949 the American Medical Directory listed the names of 201,277 physicians. Of these 9,700 were retired or were not practicing medicine, and 12,500 were associated with Federal agencies. The active non-Federal physicians included about 96,000 general practitioners, 55,000 specialists, 25,000 physicians in hospitals (mainly interns and residents), and almost 4,000 not in private practice.

In the South, the ratio of physicians to population continues to be low. In 1949, the number of active non-Federal physicians per 100,000 population was 91 for the southern States, in contrast to 116 in the North Central Region, 125 in the West, and 158 in the Northeast (New England and Middle Atlantic States). The rate for the United States was 121 active non-Federal physicians per 100,000 population.

The Division of Public Health Methods of the Office of the Surgeon General, Public Health Service, prepared this section.

Present status of health manpower

Field	Number of practitioners, 1950	Number of graduates, 1951	Number of students, 1950-51
Medicine.....	¹ 209,040	6,135	26,191
Dentistry.....	² 86,876	2,830	12,169
Nursing.....	³ 322,300	⁴ 25,790	102,509
Veterinary medicine.....	⁵ 15,305	755	3,226
Sanitary engineering.....	⁶ 5,000	403	-----

¹ American Medical Association estimate for Dec. 15, 1950. ² American Dental Directory, 1950. ³ Estimated. ⁴ 1950 data. ⁵ Includes 244 graduates from undergraduate sanitary engineering courses or options within civil engineering courses; 152 with master's degree based on major in sanitary engineering; and 7 with doctor's degree for similar major.

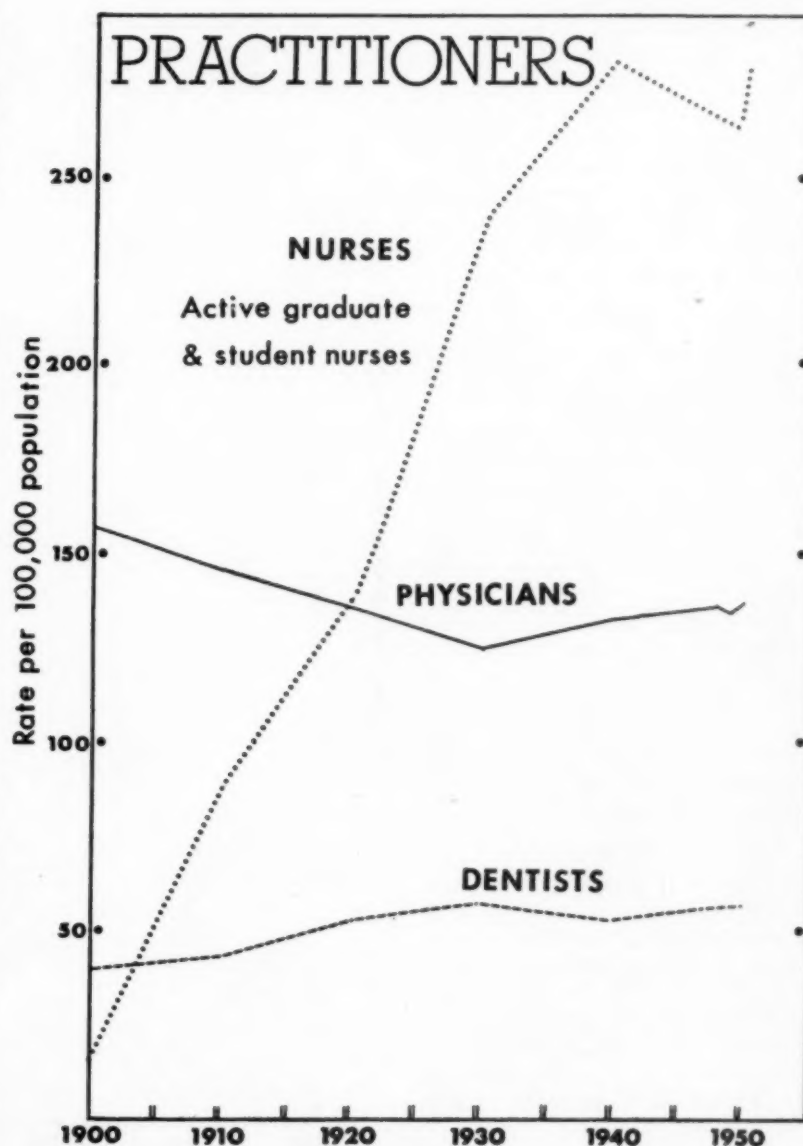


Figure 1.

The ratio of all physicians to population was lower in 1950 than at the beginning of the century (fig. 1). In 1900, there were 119,700 physicians in the United States—157 per 100,000 population. The rate declined until 1930, when there were 125 doctors for 100,000 population, then gradually increased to 133 by 1940 and to 138 by 1950.

For the year 1950-51, the total enrollment of students in the 72 medical schools and the 7 basic science schools which offer the first 2 years of the medical course was 26,191.

The total of 6,135 graduates in 1951 is the largest to date, except for the period of accelerated training during the war, when two classes graduated in 1944 (fig. 2). Prior to 1930, in addition to the number of graduates of approved medical schools, the figures included graduates of schools not meeting class A requirements. In 1910, almost 30 percent of medical school graduates were from class B and class C schools; by 1920, only 12 percent.

Dentists

There were about 87,000 dentists in the United States in 1950—57 per 100,000 population. This is a slight increase over the 1940 rate of 53, but no gain over the 1930 high of 58 (fig. 1). These dentists are unevenly located in relation to population. Low ratios exist in the South, in rural counties, and in low-income areas.

The student body of 41 approved dental schools numbered 12,169 in 1950-51, with 2,830 graduates in 1951. The 1951 graduating class was nearly double the 1949 class and, during the last two decades, it was exceeded only by the peak level of 3,212 in 1945 (fig. 2).

Nurses

Nurses outnumber any other single group of health workers. In 1950, active graduate nurses numbered about 322,300 in addition to about 103,000 students in the 1,170 State-accredited schools. There were 279 active graduate and student nurses per 100,000 population in 1950 (fig. 1). Between 1920 and 1940 the ratio was doubled.

The number of graduates rose steadily until the mid-thirties. Be-

tween 1935 and 1947, the number more than doubled—from less than 20,000 in 1935 and in 1936 to nearly 41,000. In 1948 and 1949, there was a decline, followed by an upward trend, with nearly 26,000 students graduated in 1950.

Other Personnel

Veterinary medicine is a relatively new profession. At the present time, there are more than 15,000 practitioners in this group. The estimated number of sanitary engineers is about 5,000. Forthcoming tabulations of the 1950 Census of Popu-

lation will give counts of many additional health occupation groups.

Health Department Personnel

Relatively few physicians, dentists, and nurses are employed full time in State and local health departments. According to the annual reports submitted by health departments to the Public Health Service, the total number of persons employed full time was 51,370 in 1951 and 46,063 in 1947. In 1951, State health departments accounted for 18,903 and local health departments for 32,467, with the types of personnel classification shown on the next page.

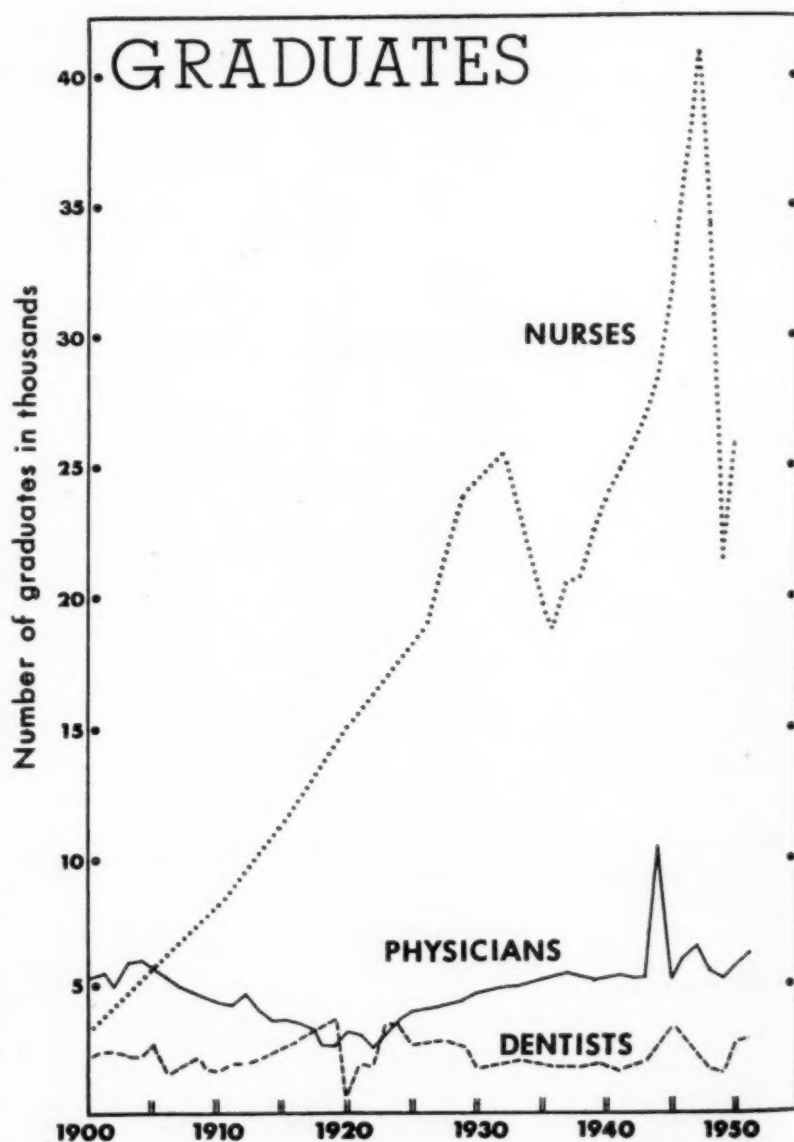


Figure 2.

	<i>Total</i>	<i>State</i>	<i>Local</i>	Data on which this summary is based are taken from the <i>Journal of the American Medical Association</i> ; the "Dental Students' Register," published by the American Dental Association; "Facts About Nursing," issued by the American Nurses Association; the <i>Journal of the American Veterinary Medical Association</i> ; and the National Roster of Sanitary Engineers, prepared by the American Public Health Association under the sponsorship of the National Security Resources Board.
Physicians.....	2, 248	734	1, 514	
Nurses.....	12, 471	1, 879	10, 592	
Dentists.....	357	135	222	
Sanitation personnel:				
Engineers.....	1, 153	872	281	
Other.....	7, 482	1, 255	6, 227	
Veterinarians.....	346	40	306	
Laboratory personnel.....	3, 077	1, 727	1, 350	
Health educators.....	477	234	243	
Nutritionists.....	223	151	72	
Medical and psychiatric social workers.....	327	193	134	
Clerical, administrative, and fiscal personnel.....	14, 694	7, 648	7, 046	
Other personnel.....	8, 515	4, 035	4, 480	

United States Delegation to Fifth World Health Assembly

Dr. Leonard A. Scheele, Surgeon General, Public Health Service, Federal Security Agency, was designated by the President to serve as chairman of the United States delegation to the Fifth World Health Assembly, which convened at Geneva, Switzerland, May 5, 1952. The Health Assembly is the policy determining body of the World Health Organization.

Other United States delegates to the Assembly are Fannie Hurst Danielson, New York City, and Dr. E. G. McGavran, dean, School of Public Health, University of North Carolina, Chapel Hill, N. C. Alternates are Dr. Frederick J. Brady and Dr. H. Van Zile Hyde, international health representatives, Division of International Health, Public Health Service, Federal Security Agency, and Howard B. Calderwood, Office of United Nations Economic and Social Affairs, Department of State.

Advisory members of the United States delegation are Donald C. Blaisdell, United States representative for Specialized Agency Affairs at Geneva; Dr. Melvin A. Casberg, chairman, Armed Forces Medical Policy Council, Department of Defense; Dr. Rolf Eliassen, professor of sanitary engineering, Massachusetts Institute of Technology, Cambridge, Mass.; Dr. George Foster, director, Institute of Anthropology, Smithsonian Institution; Joseph S. Henderson, assistant chief, Division of International Administration, Department of State; Dr. Leonard W. Larson, member, board of trustees, American Medical Association; Dr. Lloyd C. Miller, director of revision, Pharmacopoeia of the United States of America, New York City; Dr. Thomas F. Sellers, director, State Department of Public Health, Atlanta, Ga.; Dr. Knud Stowman, international health representative, Division of International Health, Public Health Service, Federal Security Agency; and Ruth Taylor, chief nursing section, Children's Bureau, Federal Security Agency.

Secretary of the delegation is Walter W. Sohl, Division of International Conferences, Department of State.

Hagerstown Health Studies

For the past 30 years, Hagerstown, Maryland, and Washington County, of which it is a part, have served as a community research laboratory for the investigation of public health problems. Beginning with a comprehensive study of illness in 1921, and expanding into a consecutive series of investigations on the prevalence of illness and impairments in the surveyed families, the Hagerstown surveys pioneered in providing long-term data on the progressive effect of illness.

This annotated bibliography has been compiled to give reference sources to the published findings and descriptions of studies and demonstrations in Hagerstown. The citations are classified in seven main sections: descriptions of the studies; morbidity surveys of families; biological factors in public health; school absenteeism and morbidity; height and weight of school children; dental examinations; and specific diseases and conditions. The listings also include a few references, without annotations, to reports of studies made in Washington County or Hagerstown that do not identify data for that community. Data on file in the Hagerstown office of the Public Health Service, available for statistical analysis, is listed.

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Turner, Violet B.: Hagerstown Health Studies. Public Health Bibliography Series, No. 6. (Public Health Service Publication No. 148). 1952. 38 pages. 20 cents.

Research Grants Awarded by the Public Health Service, 1951

This is a compilation of 1,695 research grants and 544 fellowships awarded by the National Institutes of Health of the Public Health Service, from fiscal year 1951 funds. Amounts approved for research

grants totaled \$17,120,554, of which \$5,363,642 were for general (non-categorical) grants and the remainder, \$11,765,912, in the categorical fields of arthritis and metabolic diseases, neurological diseases and blindness, cancer, dental research, microbiology, heart, and mental health. Fellowship awards totaled \$1,568,371.

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Allen, Ernest M.: Research Grants Awarded by the Public Health Service, 1951. (Public Health Service Publication No. 164). 1952. Free copies only.

Better Health For 5 to 14 Cents a Year Through Fluoridated Water

Useful as a guide to communities considering a fluoridation program, this publication contains information on the effectiveness of fluorides in preventing dental caries, the compounds that can be used, and the types of feeders which are recommended. Tests for determining the fluoride content of water are discussed, as are the costs involved. A list of some of the cities which have added fluorides to their water supplies and references to sources of feeder equipment are also given.

• • •

Better Health For 5 to 14 Cents a Year through Fluoridated Water. (Public Health Service Publication No. 62) first printing, February 1951, revised April 1951. 24 pages; illustrated; tables. 15 cents.

for the general public

Looking Forward To the Later Years

This pamphlet was written to help older people help themselves. It does not contain technical or medical information on the physiology of growing old, but offers suggestions on how the person approaching the later years can prepare himself to meet this challenge. The pamphlet

suggests that the older person "take stock" of himself by taking inventories of his health status, financial standing, relationships with his family, leisure-time activities, and social contacts. Hints are also given on ways in which the older person can make his postretirement life more pleasant—by being independent, taking play (hobbies, etc.) seriously, continuing to learn, getting along with others, learning to live with illness and disabilities, seeking help when needed, and giving help to others. Persons in the community who can be of assistance are suggested. Additional references to materials on the later years are listed.

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Looking Forward to the Later Years. (Public Health Service Publication No. 116) 1952. 12 pages. 5 cents.

Sinus Infection (Sinusitis)

The information contained in this leaflet includes a description of the sinuses, and the manner in which they can become infected. A number of causes of sinus trouble are given, along with the warning signs, such as headache or pain over the infected sinus, pain in the cheek, upper teeth, or elsewhere in the head. Some preventive measures are suggested and the treatment which the patient's physician may give him is discussed.

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Sinus Infection (Sinusitis). Health Information Series No. 34 (Public Health Service Publication No. 172). Reprinted 1952. 1-fold leaflet, 5 cents; \$1.25 per 100.

Tetanus (Lockjaw)

The seriousness of tetanus is stressed in this brief leaflet, which describes the disease and the source of infection and symptoms. Immunization is advised, particularly for those who live or work in areas where there is a special risk from tetanus. The use of antitetanus serums for treatment of persons who

have suffered punctured or torn wounds is discussed. The reader is advised to consult his health officer to determine whether he should be immunized.

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Tetanus (lockjaw). Health Information Series No. 45 (Public Health Service Publication No. 159). Reprinted 1952. 1-fold leaflet. 5 cents; \$1.50 per 100.

Neuralgia and Neuritis

Neuralgia and neuritis are described as painful disorders of one or more nerves. Symptoms and causes of facial neuralgia, localized and generalized neuritis, and sciatica are discussed. Warning is given that these symptoms may often suggest or mimic some other disease. Preventive measures suggested are regular examinations by a physician; avoidance of stress, strain, overfatigue, undue exposure to cold and damp; proper protection from dangerous chemicals; a sufficient quantity of B-vitamin foods.

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Neuralgia and Neuritis. Health Information Series No. 62 (Public Health Service Publication No. 161). Reprinted 1952. 1-fold leaflet. 5 cents; \$1.25 per 100.

Allergy

Prepared to answer inquiries on the general subject of allergy, this health information leaflet describes an allergic person, and his reactions. Some of the possible causes of allergies, such as heredity, infection, and foods eaten in excess, are discussed. The most common illness caused by allergens, hay fever, asthma, food allergies, and skin allergies are considered briefly. Specific treatment is not discussed, but the importance of cooperation between the patient and his physician is stressed.

• • •

Allergy. Health Information Series No. 32 (Public Health Service Pub-

lication No. 168). Reprinted 1952. 1-fold leaflet. 5 cents; \$1.25 per 100.

Amoebiasis

Amoebiasis and its severe form, amoebic dysentery, are discussed in terms of incidence and locality of occurrence. The cycle of infection and symptoms of both forms are given with the advice that final diagnosis can be made only by a physician.

Drug therapy and preventive measures, such as proper sanitary precautions in regard to food and water, are discussed. In areas where sanitation is poor, the boiling of drinking water and the thorough cooking of all foods are a must. Raw, leafy vegetables should be shunned although nonleafy vegetables and fruits can be eaten if scraped or peeled. Screening is also a necessary safety measure.

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Amoebiasis. Health Information Series No. 49 (Public Health Service Publication No. 157). Revised 1952. 1-fold leaflet. 5 cents; \$1.25 per 100.

Varicose Veins

Although varicose veins have been recognized since ancient times, the causes are not yet definitely known. Heredity, abdominal tumors or chronic chest conditions, and constricting clothing are suggested as possible factors.

Symptoms, such as a burning, stinging sensation and aches and cramps, are discussed. Varicose veins of long standing lead to discoloration of the legs, eczema of the skin, and eventually to ulcers. A complete physical examination is advised.

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Varicose veins. Health Information Series, No. 50 (Public Health Service Publication No. 154). Revised 1952. 1-fold leaflet. 5 cents; \$1.25 per 100.

Tapeworm

A physical description, the source of infection, and life cycle of the parasites are given for each of the three commonest types of tapeworms; beef, dwarf, and fish. Verification of diagnosis and immediate treatment by a physician are advised. Simple rules for the prevention of tapeworm are: Don't eat raw beef, pork or fish; cook food thoroughly; use modern sanitation measures; buy only meats produced under Federal or equivalent inspection.

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Tapeworm. Health Information Series No. 48 (Public Health Service Publication No. 158). Revised 1952. 1-fold leaflet. 5 cents; \$1.50 per 100.

Tularemia

The modes of transmission of tularemia, the wild animals and insects which carry the disease, and the persons usually infected are discussed in this leaflet. The symptoms are ulcers, enlarged lymph glands, and fever tending toward prostration.

Diagnosis is aided by certain laboratory tests. Streptomycin is indicated as of value in treatment. Prevention is almost entirely a matter of personal precaution. Permanent immunity follows recovery.

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Tularemia. Health Information Series No. 44 (Public Health Service Publication No. 135). Revised September 1951. 5 cents; \$1.25 per 100.

Publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication (including its Public Health Service publication number). Single copies of most publications can be obtained without charge from the Public Inquiries Branch, Public Health Service, Washington 25, D. C.

Public Health Service

Research Grants and Fellowships

On the following pages, Public Health Reports publishes the list of new research grants recommended by the National Advisory Councils of the Public Health Service and approved for payment by the Surgeon General. Lists of fellowship awards are also included. Announcements of new grants and fellowships are published after each of the three meetings held annually by the National Advisory Councils. The present listing represents actions of the February 1952 sessions.

This material has been prepared by the Division of Research Grants, National Institutes of Health.

The Public Health Service research grants program is administered by the National Institutes of Health. Its purpose is to provide financial assistance for research in the health sciences to non-Federal institutions and individual scientists. The major objectives are:

1. To expand research activities in universities and other institutions.
2. To stimulate the initiation of research in small colleges where previous research programs have been limited or nonexistent.
3. To encourage investigators to undertake research in neglected fields.
4. To provide training for scientific personnel.

National Advisory Councils

National Advisory Councils, established by law and composed of outstanding citizens skilled in the medical sciences education, and public affairs, examine all applications and recommend appropriate action. The Surgeon General may award grants only when they are recommended by one of the seven councils:

National Advisory Arthritis and Metabolic Diseases Council, National Advisory Cancer Council, National Advisory Dental Research Council, National Advisory Health Council, National Advisory Heart Council, National Advisory Mental Health Council, and National Advisory Neurological Diseases and Blindness Council.

Study Sections

In order that these advisory councils may have the benefit of the best scientific advice on applications for research grants, outstanding authorities in each of the major fields of research have been appointed as members of special study sections. Appointments are made to provide for rotation of membership. The majority of these special consultants are nongovernmental scientists selected by the Surgeon General on a nation-wide basis.

These study sections have accepted the responsibility (1) for reviewing applications for research grants in their respective fields, and forwarding their recommendations for approval, modification, further study, or disapproval to the appropriate National Advisory Council; and (2) for surveying, as scientific leaders, the status of research in their fields in order to determine areas in which research activities should be expanded. Study sections meet prior to the regularly scheduled meetings of the National Advisory Councils.

The applicant describes the research which he plans to do and provides information as to his training, experience, accomplishments, his work situation, and the facilities available. These factors are considered in detail with care by the study sections. Since there is never sufficient money to grant all worth-while re-

quests, it is necessary to provide a mechanism whereby requests compete on the basis of merit. The study sections and councils prepare a merit roll and the Surgeon General makes grants as far down the list as funds permit.

In order to insure scientific freedom and thereby promote the highest quality of research in both fundamental and applied fields, the investigators are not required to follow their original proposal but rather are free to pursue the research in whatever manner they wish and to publish their findings without clearance with the Government.

The Scope of Grants

In earlier years when the major causes of death were infectious diseases and the civilized world was continuously afflicted with severe epidemics and a very high infant mortality rate, scientists gave their attention primarily to these matters. As a result of their efforts, effective means for treating and preventing many of these diseases were discovered. General sanitation and nutrition improved and people began to live longer.

During the past few years there has developed among health agencies, physicians, and scientists an increasing preoccupation with chronic diseases of middle and old age. These diseases have increased as causes of death and disability largely as a direct consequence of the increased average life span of man. In order to keep pace with this changing emphasis of research, Congress has created in the Public Health Service's National Institutes of Health a series of new institutes concerned primarily with research in diseases such as cancer, arthritis, arteriosclerosis, and blindness.

It has not been the intention of Congress or the Public Health Service to decrease research efforts in fields such as infectious diseases but rather to maintain them at full vigor while stimulating additional research in the newer fields. The National Microbiological Institute and the Division of Research Grants have, therefore, continued to provide research support in the field of infectious disease and general medical research.

It was recognized that this expansion of re-

search effort could not be accomplished without expanding the research potential of the country. Research grants have made it possible for well-trained investigators to obtain additional assistants and equipment so that they could work at maximum efficiency. This has resulted in the training of many new investigators.

Research Fellowships

In addition, the Public Health Service conducts a research fellowship program to provide financial assistance to the most able and promising students and scholars during their training period so that they can enter a career of research in medical and allied fields. These fellowships are awarded on a competitive basis upon the recommendation of Institute specialty boards and committees of scientists at the National Institutes of Health. Annual stipends range from \$1,600 up. Scientists anywhere in the world are eligible to compete. American citizens may receive training under these fellowships at any recognized institution in the world. A small number of fellowships have been awarded to foreign students for training in the United States.

Six Years of Grants

It is gratifying to note some of the developments during the first 6 years of the expanded grant program.

The volume of research has increased substantially. This increase has not been restricted to large institutions with well-established research programs. To be sure, such institutions have made a great contribution to this increased effort but in addition—and perhaps of greater consequence in the long view—sound, substantial research programs have developed in other institutions widely distributed geographically and where little or no research existed before.

The availability of Federal funds has not diminished the degree of non-Federal support. In the period from 1946 to 1951, while Federal support was increasing twentyfold, there was a simultaneous fivefold increase of funds from private sources. Federal recognition of local ability has often provided a stimulus for increased local support.

Public Health Service Research Grants

Approved Following the February Meetings of the Advisory Councils

The subject matter of the individual studies listed here is necessarily described in abbreviated form. The descriptive titles serve only to identify the general field in which the investigator will work.

The list includes 176 new grants to 206 investigators in 100 institutions, located in 34 States including the District of Columbia, and 3 foreign countries. These grants are in support of research in a wide variety of scientific subjects and fields.

Requests for application blanks or for further information concerning the research grant and fellowship programs should be addressed to the Division of Research Grants, National Institutes of Health, Public Health Service, Bethesda 14, Md.

ALABAMA

Tuskegee

Cason, L. F., and Ford, C. M. **Tuskegee Institute.** Antibiotic properties of aryl ketones, etc.

NMI—\$7,344

Henderson, J. H. **Tuskegee Institute.** Nutritional factors in cultures of plant tissues.

NCI—\$3,277

Neal, E. E. **Tuskegee Institute.** Development of health practices in rural South.

NIH—\$20,000

CALIFORNIA

Berkeley

Hogan, M. J. **University of California.** Action of certain enzymes on eye structures.

NINDB—\$9,109

Los Angeles

Duel, H. J., Jr., Marx, W., and Slater, A. R. **University of Southern California.** Studies of cholesterol metabolism.

NHI—\$20,000

Griffith, W. H. **University of California.** Beta-amino-isobutyric acid in malignant states.

NCI—\$10,000

McVickar, D. L. **University of California.** Specific serologic tests for human fungal diseases.

NMI—\$10,292

Rittenberg, S. **University of Southern California.** Biosynthesis of nucleic acid using antagonists.

NMI—\$3,996

Salisbury, P. F. **Cedars of Lebanon Hospital.** Experimental heart failure by arterial constriction.

NHI—\$4,320

Sturgeon, P. **Children's Hospital Society.** Blood dyscrasias of children.

NIAMD—\$6,696

Santa Barbara

Bischoff, F. **Santa Barbara Cottage Hospital.** Relation of estrogens to cancer.

NCI—\$11,988

Stanford

Finley, K. H. **Stanford University.** Isotope studies on the central nervous system.

NINDB—\$14,450

Luetscher, J. A. **Stanford University.** Humoral control of circulatory function in edema.

NIAMD—\$14,536

Luft, J. **Stanford University.** Self control patterns within families.

NIMH—\$8,542

Raffel, S. **Stanford University.** Infections and contact hypersensitivities.

NIH—\$6,977

Schultz, E. W. **Stanford University.** "Common cold."

NMI—\$9,720

The source of funds for each grant is indicated by initial letters following each entry. The key to these abbreviations is as follows:

NCI	National Cancer Institute.
NHI	National Heart Institute.
NIAMD	National Institute of Arthritis and Metabolic Diseases.
NIDR	National Institute of Dental Research.
NIMH	National Institute of Mental Health.
NINDB	National Institute of Neurological Diseases and Blindness.
NIH	National Institutes of Health.
NMI	National Microbiological Institute.

CONNECTICUT

Storrs

Boettiger, E. G. University of Connecticut. A study of unique neurological mechanisms.

NINDB—\$2,792

DISTRICT OF COLUMBIA

Washington

Leese, C. E., and Bacchus, H. George Washington University. Relation of adrenal and kidney in hypertension.

NHI—\$5,000

McKinney, R. L. Howard University. Intercellular fibers in tissue cultures of cancer cells.

NCI—\$10,000

Parr, L. W., and Robbins, M. L. George Washington University. Antagonistic activity of enterobacteriaceae.

NMI—\$4,127

FLORIDA

Coral Gables

Leigh, W. H. University of Miami. Study of trematode cercariae of Florida mollusca.

NMI—\$1,971

Miami

Hopman, B. C. Medical Research Foundation of Dade County. Study of cytochemical techniques in uterine carcinoma.

NCI—\$10,854

Tallahassee

Frieden, E., and Walbornsky, H. M. Florida State University. Derivatives of phenols with thyroxine-like activity.

NIAMD—\$5,000

GEORGIA

Athens

Duncan, W. H. University of Georgia. Toxicity of vascular plants.

NIH—\$19,422

Atlanta

Bondy, P. K. Emory University. Effect of growth hormone on carbohydrate metabolism.

NIAMD—\$7,333

New grants and awards by Institute, approved by the Surgeon General, Public Health Service, following recommendations of reviewing consultants in February 1952

Institute	Research grants		Fellowship awards	
	Number of grants	Amount approved for payment	Number of awards	Amount approved for payment
Total.....	176	\$1, 831, 563	97	\$254, 500
Noncategorical: ¹				
Division of Research Grants.....	45	463, 798	24	54, 600
Categorical:				
National Institute of Arthritis and Metabolic Diseases.....	33	352, 016	1	2, 000
National Institute of Neurological Diseases and Blindness.....	10	124, 825	3	8, 800
National Cancer Institute.....	29	317, 950	22	52, 300
National Institute of Dental Research.....	3	14, 369		
National Microbiological Institute.....	28	207, 659	16	33, 800
National Heart Institute.....	20	191, 082	24	80, 000
National Institute of Mental Health.....	8	159, 864	7	23, 000

¹ "Noncategorical" research does not fall specifically within the scope of interest of any categorical institute but is presented by the Division of Research Grants, along with study section technical advice, directly to the National Advisory Health Council for consideration.

Haldi, J. Emory University. Calcium and phosphorus metabolism and experimental dental caries.

NIDR—\$5,638

Martin, J. D., Jr. Emory University. Use of ACTH in burns.

NIH—\$8,100

Schroder, S. Emory University. Excretion of gall-bladder contrast media.

NIAMD—\$4,698

Experiment

Speirs, M. Georgia Experiment Station. Seasonal effects of children's diets.

NIH—\$2,500

ILLINOIS

Chicago

Baker, R. University of Chicago. Investigation of renal antigenicity.

NIH—\$5,454

Elias, M. H. Chicago Medical School. Structure of human adrenal cortex.

NHI—\$4,320

Furuta, W. J., and Kirschbaum, A. University of Illinois. Electronmicroscopic study of the glomerulus.

NIH—\$6,048

Geiling, E. M. K. University of Chicago. Metabolism of radioactive colchicine in experimental animals.

NCI—\$5,562

Huggins, C. Individual. Synthesis of ring labeled radioactive cortisone.

NIAMD—\$66,000

Jones, R. J. University of Chicago. Serum lipids in atherosclerosis and hormonal disorders.

NHI—\$14,450

Rostenberg, A. University of Illinois. Desensitization of skin-sensitivity.

NIH—\$6,220

Sherrod, T. University of Illinois. Renal hemodynamics as influenced by drugs.

NIH—\$11,734

Evanston

Balamuth, W. Northwestern University. Comparative studies on intestinal amoeba.

NMI—\$6,804

Kirchheimer, W. Northwestern University. Arithmetic linear growth of mycobacteria.

NMI—\$5,400

Lein, A. Northwestern University. Transport, assimilation, regulating role of thyroxin.

NIH—\$7,884

IOWA

Iowa City

Cullen, S. C., Gross, E. G., and Featherstone, R. State University of Iowa. Distribution of zenon in central nervous tissue.

NIH—\$7,342

Fisher, A. K. State University of Iowa. Cellular respiration in dental tissues.

NIDR—\$6,852

Ponseti, I. V. State University of Iowa. A study of experimental dietary scoliosis.

NIAMD—\$11,124

KANSAS

Kansas City

Bolinger, R. E. University of Kansas. Carbohydrate metabolism in liver disease.

NIAMD—\$9,990

Dimond, E. G. University of Kansas. Transmission of EKG via telephone lines.

NHI—\$5,800

Grady, H. J. University of Kansas. Investigation of pregnanediol metabolism.

NIH—\$7,668

KENTUCKY

Louisville

Beard, M. F. University of Louisville. Absorption and excretion of vitamin B-12.

NIAMD—\$18,347

Rehm, W. S. University of Louisville. Electrophysiological studies of the stomach.

NIH—\$8,364

LOUISIANA

Baton Rouge

Elliott, H. B. Department of Agriculture and Immigration Livestock Sanitary Board. Serological survey of Louisiana Q-fever incidence.

NMI—\$7,781

Kehr, A. E. Louisiana State University. Nature and cause of genetic tumors in plants.

NCI—\$3,632

MAINE

Bar Harbor

Scott, J. P. R. B. Jackson Memorial Laboratory. Effect of age and strain on early behavior patterns.

NIMH—\$6,966

MARYLAND

Baltimore

Davis, D. E. Johns Hopkins University. A study of fox population for rabies control.

NMI—\$7,884

Frank, J. D. Johns Hopkins University. Evaluation of group and individual psychotherapy.

NIMH—\$39,277

Morgan, R. H. Johns Hopkins University. Cinefluorographic study of heart disease.

NHI—\$14,108

Roberts, Dean W. Commission on Chronic Illness. Study of chronic illness prevalence and needs for care.

NIH—\$55,000

MASSACHUSETTS

Amherst

Woodside, G. L. University of Massachusetts. Chemotherapeutic studies on cancer in mice.

NCI—\$8,425

Boston

Adams, R. D. Massachusetts General Hospital. Immunology in encephalomyelitis and multiple sclerosis.

NINDB—\$43,600

Astwood, E. B. New England Medical Center. Pituitary hormones.

NIH—\$18,360

Balazs, E. A. Massachusetts Eye and Ear Infirmary. Role of acid mucopolysaccharides in tissue growth.

NCI—\$9,720

Beecher, H. K. Massachusetts General Hospital. Circulatory effects of curare and other drugs.

NHI—\$12,703

Brugsch, H. G. Boston Dispensary. Long term use of ACTH in rheumatoid arthritis.

NIAMD—\$3,391

Diamond, L. K. Children's Medical Center. Blood group antibodies in human subjects.

NIH—\$13,608

Etsten, B. New England Medical Center. Assisted expiration in anesthesia.

NIH—\$6,912

Geren, B. B. Children's Medical Center. The structure of the neuron.

NINDB—\$6,156

Gergely, J. Massachusetts General Hospital. Biochemical studies on cardiac and skeletal muscle.

NHI—\$8,100

Goldstein, A. Harvard University. Function of plasma-type cholinesterase.

NIH—\$6,381

Jeanloz, R. W. Massachusetts General Hospital. Synthesis of glucosamine and chondrosamine derivatives.

NIAMD—\$7,751

Lemon, H. M. Boston University. Analytical method for 11-ketosteroid in urine of cancer patients.

NCI—\$7,000

Miller, H. H. New England Medical Center. Perfusion of isolated and in situ organs.

NIH—\$10,000

Miller, Z. B. Children's Medical Center. Mechanism of action of carcinolytic agents.

NCI—\$13,284

Naterman, H. L. Beth Israel Hospital. Studies on injected protein antigens.

NIH—\$4,968

Stefanini, M., and Dameshek, W. New England Medical Center. Platelet studies in thrombocytopenic purpura.

NIH—\$10,044

Stone, W., Jr. Massachusetts General Hospital. Study of plastic artificial corneas.

NINDB—\$4,200

Vanderlaan, W. New England Medical Center. Factors which influence thyroid function.

NIAMD—\$5,400

Cambridge

Castle, W. B. Harvard University. Destruction of red cells in hemolytic anemias.

NIH—\$8,480

Eaton, M. D. Harvard University. Rous sarcoma virus and cell proliferation.

NCI—\$7,350

Emerson, K., Jr. Harvard University. Serum phospholipid in hyperlipemic states.

NIAMD—\$6,314

Fieser, L. F. Harvard University. Sterols and steroid hormones.

NCI—\$19,184

Freedberg, A. S., and Hamolsky, M. W. Harvard University. Thyroid hormonal metabolic pool in man.

NIAMD—\$10,708

Ipsen, J., and Mueller, J. H. Harvard University. Behavior of coccidioides in tissue culture.

NMI—\$20,000

Janeway, C. A. Harvard University. Immunology and sterilization of blood derivatives.

NHI—\$14,358

Medford

Bernfeld, P. Tufts College. Micro-electrophoretic study of mice plasma proteins.

NCI—\$6,008

Worcester

Cranswick, E. H. Clark University. Thyrotropic responsivity in schizophrenia.

NIMH—\$8,705

Kegeles, G. Clark University. Sedimentation and diffusion of small molecules.

NIH—\$24,082

MICHIGAN

Ann Arbor

Aberle, D. F. University of Michigan. Peyote use among the Navajo Indians.

NIMH—\$6,217

Baker, B. L. University of Michigan. ACTH and the histology of the digestive tract.

NIAMD—\$9,423

Bordin, E. S., Dittmann, A. T., and Rausch, H. L. University of Michigan. Analyses of psychotherapeutic interaction.

NIMH—\$19,990

Detroit

Gerheim, E. B. University of Detroit. Studies of blood group specific substances.

NHI—\$4,203

Maddock, W. O. Wayne University. Urinary estrogens in man.

NIAMD—\$7,020

MINNESOTA

Minneapolis

Bloch, H. S., and Kreman, A. J. University of Minnesota. Physiological significance of gastric urease.

NIH—\$6,309

Lifson, N. University of Minnesota. Metabolism in perfused mammalian skeletal muscle.

NIH—\$7,236

MISSOURI

Kirkville

Korr, I. M., and Corson, S. A. Kirkville College. Renal reflex patterns and pathways.

NIH—\$9,590

St. Louis

Germuth, F. Washington University. Studies on experimental hypersensitivity.

NIH—\$12,900

Kamen, M. D. Washington University. Metabolism of photosynthetic bacteria.

NMI—\$7,279

Luyet, B. J. St. Louis University. Preservation of life in frozen cells with glycerol.

NIH—\$6,120

Mercer, F. L. St. Louis College of Pharmacy and Allied Sciences. Inhibition of tobacco mosaic virus synthesis by analogs.

NMI—\$3,850

Schoepfle, G. M. Washington University. Studies in impulse conduction.

NINDB—\$6,696

NEBRASKA

Lincoln

Dunn, F. L., and Bahm, W. E. Jr. University of Nebraska. Frequency, timing, and transmission of heart murmurs.

NHI—\$8,208

Omaha

Gillick, F., and Egan, R. L. Creighton University. Electrokymographic study of ventricular motion.

NHI—\$12,906

NEW YORK

Albany

Frawley, T. F. Albany Medical College. Chemistry of saliva related to adrenal cortical hormones.

NIAMD—\$8,128

Robb, J. S. Research Foundation of State University of New York. Studies of specialized heart tissue.

NHI—\$5,000

Brooklyn

Pincus, J. B., and Gittleman, I. F. Jewish Hospital of Brooklyn. Effect of human and cow milk on newborn infants.

NIAMD—\$6,000

Volk, B. W., and Lazarus, S. S. Jewish Sanitarium and Hospital for Chronic Diseases. Mechanism for hypoglycemia responsiveness.

NIAMD—\$5,000

Buffalo

Griffith, F. R., and Hubbard, R. S. University of Buffalo. Role of sympathetic nerves of kidney in hypertension.

NHI—\$3,841

Lowe, C. U. University of Buffalo. Effect of cortisone on liver nucleic acid metabolism.

NCI—\$9,864

Ithaca

Holley, R. W. Cornell University. New methods of peptide synthesis and degradation.

NIH—\$5,000

New York

Bender, M. B. Mt. Sinai Hospital. Effect of cerebral lesions on visual perception.

NINDB—\$19,440

Benham, R. W. Columbia University. Nutritional demands of pathogenic fungi.

NMI—\$5,130

Bodansky, O., and Randall, H. T. Sloan-Kettering Institute, Memorial Center for Cancer and Allied Diseases. Intercellular phase in patients with cancer.

NCI—\$18,000

Buxton, C. L. Columbia University. Cervical bacteriology and human sterility.

NMI—\$19,440

Edwards, G. P. New York University. Effect of detergents on activated sludge.

NIH—\$5,238

Fishman, A. P. Mt. Sinai Hospital. Studies on normal and pathological pregnancies.

NHI—\$13,381

Glass, G. B. New York Medical College. Vitamin B-12 in anemia after gastrectomy.

NIAMD—\$15,120

Leiter, L. Montefiore Hospital. Malnutrition in prolonged illness.

NIAMD—\$20,000

Luckey, E. H., and Knight, J. V. Cornell University. Fluid and electrolyte balance in acute infections.

NMI—\$12,020

Mendlowitz, M. Mt. Sinai Hospital. Effect of drugs on neurogenic vascular resistance.

NHI—\$8,100

Rennie, T. A. C. Cornell University. Yorkville community mental health project.

NIMH—\$32,886

Riker, W. F. Cornell University. Anti-fibrillatory effect of curare.

NIH—\$11,610

Seegal, D. Columbia University.

Metabolic abnormalities resulting from rice diets.

NIAMD—\$8,100

Spain, D. M. Waldemar Medical Research Foundation. Effect of cortisone on acute inflammatory processes.

NCI—\$7,030

Smith, H. W. New York University. Cardiovascular - renal physiology and disease.

NHI—\$20,674

Taylor, H. C., Jr., and Plentl, A. A. Columbia University. Tracer studies on placental and uterine blood flow.

NIH—\$10,638

Rochester

Holler, J. W. Highland Hospital. Effect of epinephrine on serum potassium and adrenal cortex.

NIAMD—\$3,942

Lambooy, J. P. University of Rochester. Inhibition of rat carcinoma by diethyl riboflavin.

NCI—\$3,872

NORTH CAROLINA

Chapel Hill

Jenner, C. University of North Carolina. Action spectrum for animal photoperiodic response.

NMI—\$5,395

Thurstone, L. L., and Thurstone, T. G. University of North Carolina. Studies of primary mental abilities.

NIMH—\$37,281

Durham

Engel, F. L., and Meyers, J. D. Duke University. Effects of hormones and metabolic factors on certain liver functions.

NIAMD—\$10,000

Kerby, G. P. Duke University. Pyrogen disappearance from blood stream.

NIH—\$3,780

Martin, S. P. Duke University. Effect of bacterial products on human leukocytes.

NIH—\$7,479

Shingleton, W. Duke University. Modification of resistance in sphincter of Oddi.

NIAMD—\$3,240

Raleigh

Smallwood, C. North Carolina State College. Adsorption capacity of activated sludge.

NIH—\$9,039

NORTH DAKOTA

Fargo

Chernick, S. North Dakota Agricultural College. Control of pancreatic enzyme formation.

NIAMD—\$7,000

OHIO

Cincinnati

Glueck, H. I. May Institute for Medical Research of the Jewish Hospital Association. Natural clotting factors with ninhydrin.

NIH—\$4,860

Sherry, S. May Institute for Medical Research of the Jewish Hospital Association. Biochemical studies of fibrous tissue inflammation.

NIH—\$9,612

Cleveland

Herndon, C. H. Western Reserve University. Transplantation of whole joints.

NIAMD—\$10,000

Hirschmann, H. Western Reserve University. Chemistry and metabolism of adrenal steroids.

NCI—\$5,994

Latta, H. Western Reserve University. Interaction of soluble proteins and tissue cells.

NIH—\$9,930

Weisberger, A. Western Reserve University. Role of cysteine compounds in leukopoiesis.

NCI—\$5,934

Columbus

Cole, C. R. Ohio State University. Toxoplasmosis in domestic animals and in man.

NMI—\$5,650

Ferguson, L. C., and Bohl, E. H. Ohio State University. Epidemiologic studies of leptospiroses.

NMI—\$5,400

Von Haam, E. Ohio State University. Biologic testing of carcinogenic hydrocarbons.

NCI—\$6,222

OKLAHOMA

Oklahoma City

Reifenstein, E., and Howard, R. P. Oklahoma Medical Research Institute and Hospital. Atrophy of bone resulting from disuse.

NIAMD—\$19,602

Tulsa

Stowell, A. Springer Clinic. Localization of tactile and auditory areas.

NINDB—\$8,294

OREGON

Corvallis

Cheldelin, V. H. Oregon State College. Metabolism of acetic acid bacteria.

NMI—\$6,250

Portland

Harris, J. E. University of Oregon. Studies on aqueous humor and plastic corneas.

NINDB—\$10,288

PENNSYLVANIA

Philadelphia

Aptekman, P. M. Wistar Institute of Anatomy and Biology. Tumor immunity studies in inbred rats.

NCI—\$7,948

Delamater, E. D. University of Pennsylvania. Biology of spirochetes and spirochetoses.

NMI—\$9,813

Hausberger, F. X. Jefferson Medical College. Synthesis of fat from carbohydrates.

NIAMD—\$6,652

Hauschka, T. Institute for Cancer Research and Lankenau Hospital Research Institute. Chromosomal differences of cells in ascites tumors.

NCI—\$5,393

Israel, H. L. University of Pennsylvania. Epidemiological-immunological study of sarcoidosis.

NMI—\$3,493

Lurie, M. B. University of Pennsylvania. Genetic factors in resistance to tuberculosis.

NMI—\$4,644

Sano, M. Woman's Medical College of Pennsylvania. Tissue cultures of pleural effusions.

NIH—\$4,860

Smith, N. J. St. Christopher's Hospital for Children. Hematological aspects of iron metabolism in infancy.

NIAMD—\$6,900

Pittsburgh

Leung, S. W. University of Pittsburgh. CO₂ effect on solubility of oral calculus.

NIDR—\$1,879

SOUTH CAROLINA

Columbia

Riley, E. E. Benedict College. Protein deficient diets and kidney function.

NHI—\$3,780

SOUTH DAKOTA

Vermillion

Cox, C. D. University of South Dakota. Micro-detection of antigenic substances.

NMI—\$3,900

TENNESSEE

Nashville

Darby, W. J., and Woodruff, C. W. Vanderbilt University. Deficiency of pteroylglutamates and ascorbic acid.

NIAMD—\$16,173

TEXAS

Galveston

Rigdon, R. H. University of Texas. Production of tumors with methylcholanthrene.

NCI—\$5,508

Houston

Rose, J. M. Baylor University. Immunologic studies in Hodgkin's disease.

NCI—\$11,000

Turner, R. B. Rice Institute. Structure of ouabagenin.

NHI—\$7,830

San Antonio

McKinney, R. E. Southwest Foundation for Research and Education. Bacterial flocculation in aerobic waste treatment.

NMI—\$11,232

Waco

Bond, T. J. Baylor University. Carcinogens and metabolism of micro-organisms.

NCI—\$1,512

UTAH

Salt Lake City

Gebhardt, L. P. University of Utah. Hemagglutination test for yellow fever virus.

NIAMD—\$8,638

Leymaster, G. R. University of Utah. Study of metabolism of selenium and tellurium.

NIH—\$6,966

VERMONT

Burlington

Schein, A. H. University of Vermont. Purification of purine enzymes.

NIAMD—\$4,428

WASHINGTON

Pullman

Drake, C. H. Washington State College. Immunization for sporotrichosis and nocardiosis.

NMI—\$2,646

Seattle

Cantril, S. T. Swedish Hospital. Therapeutic effectiveness of 2 mev X-rays in cancer.

NCI—\$88,341

Everett, N. B. University of Washington. Localization and metabolism of labeled hormones.

NCI—\$6,048

Harkins, H. N. University of Washington. Evaluation of the Billroth I operation.

NIH—\$8,990

Roman, H. University of Washington. Production of exceptional asci in saccharomyces.

NMI—\$7,560

WEST VIRGINIA*Morgantown*

Marsh, D. F. University of West Virginia. Mannich bases and their quaternary salts. NIH—\$4,696

WISCONSIN*Madison*

Meyer, R. K., and Emlen, J. T., Jr. University of Wisconsin. Stress and survival in natural populations. NIH—\$8,397

ARGENTINA*Buenos Aires*

Leloir, L. F. Campomar Fundacion Instituto de Investigaciones. Enzymes and coenzymes acting on hexosephosphates. NIH—\$10,000

CANADA*Montreal*

Rose, B. McGill University. Hypersensitivity and protein metabolism. NIH—\$25,000

Venning, E. H. McGill University. Urinary excretion of conjugated corticoids.

NIAMD—\$8,000

INDIA*Bombay*

Khanolkar, V. R. Indian Cancer Research Centre. Testing of Indian tobaccos for carcinogenicity.

NCI—\$9,000

Public Health Service Research Fellowship Awards

During the February meetings of the Institute specialty boards, 97 new fellowship awards were approved totaling \$254,500. Also approved, but not listed here, were 53 continuation awards totaling \$143,908. Annual stipends range from \$1,600 up.

Types of fellowships are identified immediately after each name:

(PB) predoctorate, bachelor. (PD) postdoctorate.
(PM) predoctorate, master. (SP) special.

ALABAMA*Auburn*

Konde, W. (PD) Alabama Polytechnic Institute. Department of Animal Husbandry and Nutrition. NCI

Birmingham

Walker, R. P. (PD) Medical College of Alabama. Department of Medicine. NHI

CALIFORNIA*Berkeley*

Ogasawara, F. X. (PB) University of California. Department of Poultry Husbandry. NIH

Smith, K. C. (PD) University of California. Department of Biochemistry. NCI

Los Angeles

Bruice, T. C. (PM) University of Southern California. Department of Biochemistry and Chemistry. NIH

Heim, W. G. (PM) University of California. Department of Zoology. NCI

Jorgensen, E. C. (PM) University of California. Department of Chemistry. NIH

Yuhl, E. T. (PD) University of California. Department of Anatomy. NINDB

Pasadena

Gershowitz, H. (PM) California Institute of Technology. Kerckhoff Laboratory of Biology. NCI

COLORADO*Denver*

McCord, M. C. (PD) University of Colorado. Department of Medicine. NHI

Sherwood, C. (PM) University of Colorado. Department of Anatomy. NINDB

CONNECTICUT*New Haven*

Davis, M. (PM) Yale University. Department of Biophysics. NCI

Kessen, W. H. (PD) Yale University. Institute of Human Relations. NIMH

Lipsky, S. R. (PD) Yale University. Department of Internal Medicine. NHI

St. Lawrence, P. (PD) Yale University. Department of Botany. NMI

Woese, C. R. (PM) Yale University. Department of Biophysics. NMI

DISTRICT OF COLUMBIA*Washington*

Fearn, J. E. (PM) Catholic University. Department of Chemistry. NIH

ILLINOIS*Chicago*

Aserinsky, E. (PM) University of Chicago. Department of Physiology. NIMH

Berenson, G. S. (PD) University of Chicago. Department of Pediatrics. NHI

Dillon, R. F. (PD) Hektoen Institute for Medical Research. Cardiology Laboratory. NHI

Urbana

Campbell, A. McC. (PM) University of Illinois. Department of Bacteriology. NMI

Hughins, E. J. (PM) University of Illinois. Department of Zoology. NMI

Zahler, S. A. (PD) University of Illinois. Department of Bacteriology. NMI

INDIANA

Lafayette

Mallett, G. E. (PM) Purdue University. Department of Biological Sciences. NMI

Parlett, R. C. (PM) Purdue University. Department of Biological Sciences. NCI

South Bend

Boyle, R. J. (PM) Notre Dame University. Department of Chemistry. NCI

Loffelman, F. F. (PM) Notre Dame University. Department of Chemistry. NMI

IOWA

Iowa City

Tremaine, M. M. (PM) The State University of Iowa. Department of Bacteriology. NMI

KANSAS

Lawrence

Eberle, B. T. (PD) University of Kansas. Department of Physiology. NHI

Pryor, C. W. (PM) University of Kansas. Department of Zoology. NMI

KENTUCKY

Louisville

Loudermill, P. (PB) University of Louisville. Department of Anatomy. NHI

MARYLAND

Baltimore

Brahen, L. S. (PM) University of Maryland. Department of Pharmacology. NHI

The source of funds for each grant is indicated by initial letters following each entry. The key to these abbreviations is as follows:

NCI	National Cancer Institute.
NHI	National Heart Institute.
NIAMD	National Institute of Arthritis and Metabolic Diseases.
NIDR	National Institute of Dental Research.
NIMH	National Institute of Mental Health.
NINDB	National Institute of Neurological Diseases and Blindness.
NIH	National Institutes of Health.
NMI	National Microbiological Institute.

Haley, A. J. (PM) Johns Hopkins University. Department of Parasitology. NMI

Husson, G. S. (PD) Johns Hopkins University. Department of Environmental Medicine and Surgery. NHI

Jackson, D. P. (PD) Johns Hopkins University. Department of Medicine. NHI

Praglin, J. (PD) Johns Hopkins University. Department of Biophysics. NINDB

Wallis, R. C. (PM) Johns Hopkins University. Department of Parasitology. NMI

Wolff, J. B. (PM) Johns Hopkins University. Department of Biology. NIH

MASSACHUSETTS

Boston

Ames, A., III. (PD) Harvard University. Department of Biochemistry. NIMH

Bernard, G. R., Jr. (PM) Boston University. Department of Biology. NMI

Bluhm, A. L. (PM) Boston University. Department of Chemistry. NCI

Brooks, L. (PD) Harvard University. Department of Surgery. NHI

Bucklin, D. H. (PD) Harvard University. Department of Biology. NIH

Dalton, J. C. (PD) Harvard University. Department of Medicine. NHI

Epstein, S. I. (PM) Harvard University. Department of Chemistry. NMI

Friedman, I. H. (PD) Boston University. Department of Clinical Research. NHI

Goldschmidt, E. N. (PM) Harvard University. Department of Chemistry. NIH

Granstrom, M. L. (PM) Harvard University. Department of Sanitary Engineering. NIH

Guild, W. R. (PD) Harvard University. Department of Medicine. NHI

Ketchum, W. F. (PD) Harvard University. Department of Biological Chemistry. NCI

Lear, A. A. (PD) Harvard University. Thorndike Memorial Laboratory. NHI

Levine, S. G. (PM) Harvard University. Department of Chemistry. NIH

Rabinowitz, M. (PD) Harvard University. Department of Medicine. NHI

Rosenblum, M. (PM) Harvard University. Department of Chemistry. NIH

Ross, R. S. (PD) Harvard University. Department of Physiology. NHI

Rutenburg, S. H. (PD) Harvard University. Department of Surgical Research. NCI

Stone, R. W. (PD) Boston University. Department of Clinical Research. NHI

Thompson, T. E. (PM) Harvard University. Physical Chemistry Laboratory. NIH

Cambridge

Rothstein, F. (PM) Massachusetts Institute of Technology. Department of Biology. NIH

MICHIGAN

Detroit

Nussbaum, A. L. (PM) Wayne University. Department of Chemistry. NIH

MINNESOTA

Minneapolis

Miroff, G. (PM) University of Minnesota. Department of Physiology. NCI

MISSOURI

St. Louis

Chernoff, A. I. (SP) Washington University. Department of Internal Medicine. NCI

Kempinsky, W. H. (PD) Washington University. Department of Neuropsychiatry. NINDB

Smith, K. (PD) Washington University. Department of Neuropsychiatry. NIMH

Weiss, J. M. (PD) Washington University. Department of Anatomy. NIH

NEW YORK

Brooklyn

Parris, C. L. (PM) Polytechnic Institute of Brooklyn. Department of Chemistry. NIAMD

Ithaca

Dayton, Z. D. (PM) Cornell University. Department of Plant Breeding. NCI

Woodward, V. W. (PM) Cornell University. Department of Plant Breeding. NMI

New York

Baum, G. (PD) New York University. Department of Ophthalmology. NIMH

Cluff, L. E. (PD) Rockefeller Institute for Medical Research. Rheumatic Fever Department. NMI

Dickason, M. E. (PD) Columbia University. Department of Pharmacology. NIH

Kanter, D. M. (PD) Columbia University. Department of Medicine. NHI

Kirby, K. (PD) Columbia University. Department of Neuropathology. NCI

Melnitsky, I. (PD) Sloan-Kettering Institute, Memorial Center for Cancer and Allied Diseases. Physics Department. NIH

Strange, L. F. (PD) Columbia University. Department of Neuropathology. NCI

NORTH CAROLINA

Durham

Golden, J. B. (PD) Duke University. Department of Surgery. NHI

OHIO

Cleveland

Hurwitz, J. (PM) Western Reserve University. Department of Biochemistry. NIH

Moir, T. W. (PD) Western Reserve University. Department of Medicine. NHI

Rose, I. A. (PD) Western Reserve University. Department of Medicine. NCI

PENNSYLVANIA

Bryn Mawr

White, J. F. (PM) Bryn Mawr College. Department of Biology. NCI

Philadelphia

Goldstein, L. (PM) University of Pennsylvania. Department of Zoology. NCI

Kern, H. M., Jr. (PD) University of Pennsylvania. Department of Anatomy. NIMH

Ludwig, G. D. (PD) University of Pennsylvania. Department of Medical Physics. NIH

Novack, P. (PD) Hahnemann Medical College. Department of Research. NHI

Pittsburgh

Matthews, J. S. (PM) University of Pittsburgh. Department of Chemistry. NIH

State College

Pioch, R. P. (PD) Pennsylvania State College. Department of Chemistry. NIH

UTAH

Provo

Bradshaw, W. H. (PB) Brigham Young University. Department of Bacteriology. NCI

Salt Lake City

Spackman, D. H. (PM) University of Utah. Department of Biochemistry. NCI

TENNESSEE

Memphis

DiLuzio, N. R. (PM) University of Tennessee. Department of Physiology. NIH

VIRGINIA

Blacksburg

Schneider, R. E. (PM) Virginia Polytechnic Institute. Department of Statistics. NCI

Charlottesville

Darby, R. A. (PB) University of Virginia. Department of Chemistry. NIH

WASHINGTON

Seattle

Elgee, N. J. (PD) University of Washington. Department of Medicine. NHI

WISCONSIN

Madison

Growth, D. P. (PM) University of Wisconsin. Department of Oncology. NCI

Rutter, W. J. (PD) University of Wisconsin. Institute for Enzyme Research. NIH

CANADA

Montreal

Mitchell, M. L. (PD) University of Montreal. Department of Experimental Medicine. NHI

SWEDEN

Stockholm

Lewis, U., Jr. (PD) Karolinska Institutet. Medical Nobel Institute. NIH

SWITZERLAND

Basel

Walborsky, H. M. (PD) University of Basel. Department of Organic Chemistry. NIH

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